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ABSTRACT

This curriculum guide presents basic definitions, models, and examples as a framework that individual technology education instructors or departments can use to construct their own units, courses, and curricula at any level. An overview describes the development of the model and the content of technology education. Section I explains technology. Section II presents technology as a process. The rationale, goals, and content are set forth for technology education in elementary, middle/junior high, and senior high schools. Section III describes and explains use of the content model for technology education. This section provides information on each of the four content area systems into which the content of technology education has been divided: communications, transportation, production, and energy. For each system, the following are provided: definition; rationale; specific examples at the three levels of development; examples of items specific to that system that constitute the components of technological systems; and an outline for studying the system. Section IV provides information on developing technology learning activities (TLAs). Eleven sample TLAs are included. Components include problem statement, objectives, materials and resources, limitations, procedures, evaluation, and feedback. Appendixes include lists of resources and transparency masters. (YLB)

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THE CURRICULUM GUIDE FOR TECHNOLOGY EDUCATION IN MAINE

Developed By:

The Technology Education Association of Maine,

The Bureau of Vocational Education, and

The Department of Technology at The University of Southern Maine

for

The Department of Education and the Technology Educators of Maine

CE 056 432

U.S. DEPARTMENT OF EDUCATION
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An Overview of the Curriculum Guide for Technology Education in Maine

Developed By:

The Technology Education Association of Maine,

The Bureau of Vocational Education, and

The Department of Technology at
The University of Southern Maine

for

The Department of Education
and the Technology Educators of Maine
1990

FOREWORD

"The world today is fast changing. We are in the middle of a technological era in which the level of sophistication of tomorrow's workers will play an increasingly greater role. Technological literacy is vital if we are to continue to grow as a nation. I fully support and admire your efforts to upgrade the industrial arts curriculum to assist students in making the transition between the types of skills needed for earlier decades and the types of skills that will be needed in the year 2000 and beyond."

Senator George J. Mitchell

"I am pleased to contribute my thoughts to the Curriculum Guide prepared by the Technology Education Association of Maine (T.E.A.M.) in conjunction with the University of Southern Maine and the State Department of Education. As Maine enters the 21st Century, a technologically literate population will be essential to our economic growth and the success of our democratic institutions. The economic future of our State depends on a well-trained work force which can respond to challenges effectively. Technology has an increasingly significant effect on our lives and our citizens will need a complete understanding of its implications in order to make informed decisions. By educating our young people to be technologically literate, school administrators, teachers, and parents are doing a tremendous and vital service to Maine and the Nation."

Senator William S. Cohen

"As Maine prepares to enter the twenty-first century, parents, educators and all of society need to address the question, "What will today's students need to know tomorrow?" In recently our world has experienced many dramatic changes and the rate of change will continue to accelerate in the future. The driving force behind this change is technology. We are becoming better and more efficient at what we do, the time it takes has been reduced, and the results of our actions can influence people and events around the world. For this reason, it is of paramount importance that tomorrows leaders receive training today that will enable them to understand and manage technology wisely.

Ernest Boyer, in his 1982 book High School: A Report on Secondary Education in America described this need as follows:

> "The great urgency is for "technology literacy," the need for students to see how society is being reshaped by our inventions, just as tools of earlier eras changed the course of history. The challenge is not learning how to use the latest piece of hardware, but asking when and why it should be used." (p.111)

The Department of Education is committed to providing the best and most meaningful education to Maine students. This "Curriculum Guide for Technology Education in Maine", is intended to improve Technology Education in the state, and result in better preparing today's youth for tomorrow. I thank the members of the committee and appreciate their efforts in the development of this publication."

Eve M. Bither, Maine Commissioner of Education

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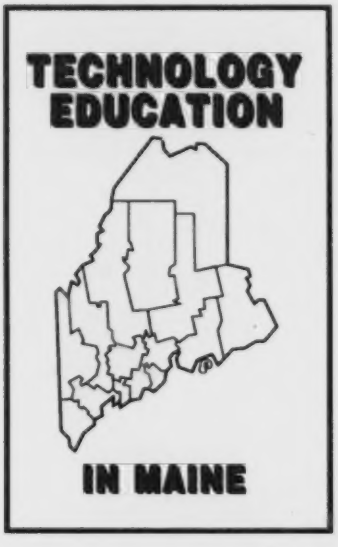

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The Affirmative Action officer and Title IX Coordinator is Rosemary Foster. She may be reached at 289-4482 or by mail at State House Station #23, Augusta, Maine 04333.

INTRODUCTION

This abbreviated version of the *Technology Education Curriculum Guide for the State of Maine* is intended to give interested persons an introduction to Technology Education and an overview of the complete guide. The curriculum guide is the result of a Carl D. Perkins grant and many hours of work by representatives from the Department of Technology at the University of Southern Maine, the Maine Department of Education and technology teachers from around the state who make up the Technology Education Association of Maine (TEAM). By developing an understanding of Technology Education, its goals, processes, and content, it is hoped that more people will become aware of and appreciate the need for Technology Education by all students at all grade levels.

The purpose of this curriculum development project is to assist the profession as it makes the transition from Industrial Arts Education to Technology Education. Unlike previous Maine curriculum guides, the complete guide is neither a "cookbook" nor an attempt to define the specific nature of individual programs. It does, however, present basic definitions, models, and examples that will provide a framework which individual instructors or departments can use to construct their own units, courses, and curriculums. With this thought in mind, one needs to realize, that the curriculum guide is intended to be both flexible and constantly evolving.

The need for change is clear. During the past 200 years, our country has experienced an incredible rate of industrial and technological change which has significantly affected our way of life. We have gone through an agrarian age, an industrial revolution and now have entered an electronic age characterized by an explosion of information and knowledge. Technology has been the driving force behind these changes.

Technological growth and development will continue and the rate at which it occurs will increase. Consequently, it will become increasingly more difficult for people to comprehend and manage technological progress. The critical question arises —

"How do we educate ourselves for the technological world?"

A key component to the answer lies in the development and implementation of a Technology Education program in our educational process.

As a society, we need to develop and maintain a high level of technological literacy. This literacy is especially important for today's youth, for it is they who will be competing in a global economy that is only beginning to be defined. Critical issues include evaluating the ethical, moral and legal aspects of technology at the ballot box, dealing with the impacts of technology on society, coming to grips with environmental problems, and, in short, managing technology in the 21st Century.

DEFINITIONS

Technology is a uniquely human activity which is used to solve problems and extend capabilities through the manipulation of the environment. It differs from the closely related area of science which has as its purpose the understanding of natural phenomena, and not their control and manipulation. Technology is also not hardware, such as cars, airplanes, computers, or robots; they are examples of solutions to specific problems i.e. the results or products of technology. However, examining the solutions, their design, evolution, and impacts is a necessary part of understanding technology.

TECHNOLOGY EDUCATION DEFINED:

The action-based discipline devoted to the application of human activity to solve problems and extend capabilities through the manipulation and control of the environment using knowledge, creativity, and resources.

Technology Education is education about technology - its processes, evolution, systems, resources, limiting factors, impacts, products, and problem in their cultural, environmental, and historical context. Through problem solving processes and Technology Learning Activities, students will research, study, create, and evaluate devices. As a result of Technology Education students will better understand the world in which they live and be better prepared for the future.

MISSION OF TECHNOLOGY EDUCATION

It is the mission of Technology Education to advance technological literacy at all levels, and prepare our citizenry to live in and contribute to our technologically-based society.

STUDENT POPULATION SERVED

Technology Education is a vital area of study for all students: gifted and talented, general, special needs, disadvantaged, at risk, or those in other classifications; regardless of their race, sex, color, national origin, religion, marital status, age or handicap. They all will have the opportunity for active involvement in the decisions and the creation of technology, which will influence their daily lives and contribute to their well being and success.

GOALS AND OBJECTIVES OF TECHNOLOGY EDUCATION

The goal of Technology Education is to produce a technologically literate society.

Students develop technological literacy necessary for global survival through the research, design and solution of "real-world" technological problems. As students investigate these relevant problems in activity-based laboratories, they learn about the history and impact of the different technological systems in which the problems are found. It is through further study of these systems that the learner understands the development of systems, components and their interrelationships. This helps him or her realize that action on one part of the system has "real–world" consequences elsewhere. Interdisciplinary activities provide an example of this interrelatedness within the educational system.

"Hands-on/minds-on", developmentally appropriate, problem-solving activities nurture the formal thinking skills that are required by the citizenry of the twenty-first century. This cognitive growth is accompanied by development of the social skills necessary to work with others in a task-oriented environment.

As a result of the wide variety of laboratory experiences in technology education, students will develop:

1. An understanding of technological systems in terms of their history, evolution, organization, components, occupations, contexts, and scientific principles.

2. An understanding of the interrelatedness of technology and the sciences, mathematics, language arts, history, social studies, and fine arts.

3. Career awareness through an understanding of individual skills and interests as they relate to the technologies used by various occupations.

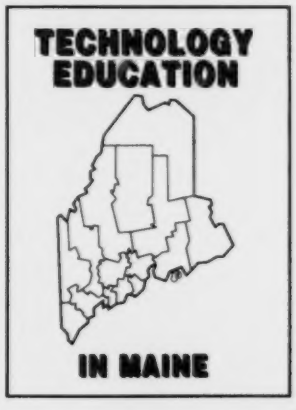
4. Critical thinking skills necessary to evaluate technology and its products in their environmental, cultural, and individual contexts.

5. Creative problem solving skills necessary to identify, develop, implement, and evaluate solutions to technological problems.

6. Basic skills in the safe use of tools, materials, and processes of technology.

7. An attitude of responsibility for the effects of technology on the environment, culture, and individual.

8. Desirable social skills such as cooperation, self-confidence, leadership, and tact.



THE EVOLUTION OF TECHNOLOGY EDUCATION

Since early in this century, the field of industrial education (industrial arts and secondary vocational education) has made major contributions to millions of students as they have studied their technical heritage and have prepared for the world of work. Its content base dealt with the tools, materials, processes, and occupations associated with the industrial growth and progress our country has made from its inception into the 1950's. It was during the decade of the 1950's that a new era began to evolve - the Electronic Age - characterized by computers, microprocessors, telecommunications, biotechnology, and others. These innovations have had a dramatic effect on our culture and environment and it has become obvious that the industrial education of the past is no longer adequate. Consequently it has become necessary to reexamine the content base and process used to develop technological literacy for all citizens.

As that examination progressed, industrial education expanded the scope and sequence of course offerings to emphasize current and emerging technology and methodology appropriate for the twenty-first century. Thus, a new name and image were created —TECHNOLOGY EDUCATION. In promoting this new movement, the industrial arts profession changed the name of its international association in 1985 from The American Industrial Arts Association (AIAA) to the International Technology Education Association (ITEA). Since then, numerous state affiliates, school systems, and universities have changed their programs and produced curriculum guides to focus on technology education.

The movement to technology education has been an evolutionary one that has built on programs of the past. Some of the basic content of previous approaches remains a part of technology education, but its emphasis has been changed to introduce a wider scope and direction. Figure 1 shows that technology education has evolved from iindustrial arts which had been built on industrial and craft skills. The thrust has shifted to the study of systems, those systems including their historical and cultural context, the relationship of technological activity to the environment, and an increased emphasis on interdisciplinary study and problem solving.

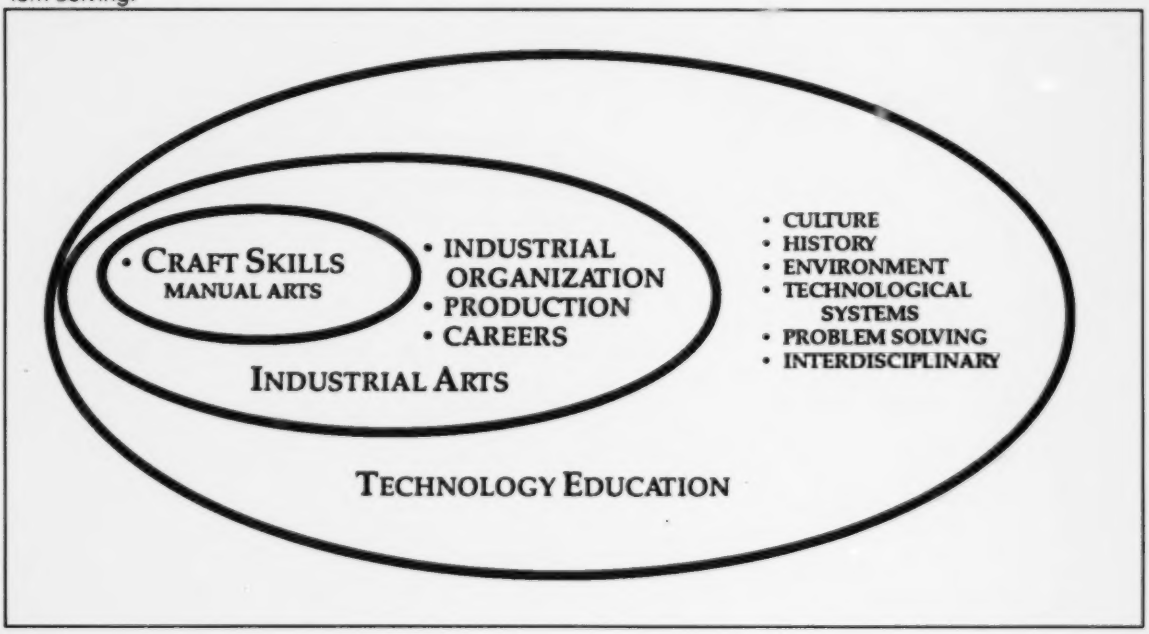


Figure 1: Evolution of Technology Education

A CURRICULUM MODEL FOR TECHNOLOGY EDUCATION IN MAINE

Technology Education should consist of a sequence of courses from middle school through senior high school with technology education activities in the elementary schools being integrated into the regular curriculum. The activities and courses should progress from awareness building experiences in the early grades through high level technical problem solving experiences at the upper grade levels. There are many variations of the specific form such curriculums may take, and it is expected that they will be adapted to the various schools, laboratories, and student abilities and interests found in Maine. The model shown in Figure 2 is consistent with the vision presented in this guide, and with the Technology Education movement nation wide. The titles in the various sections are not suggested as specific course titles, but as descriptors of the focus at that level. The arrows show that a focus on the historical context of technology, problem solving, cultural and societal impacts, and career literacy should be an integral part of courses at all levels.

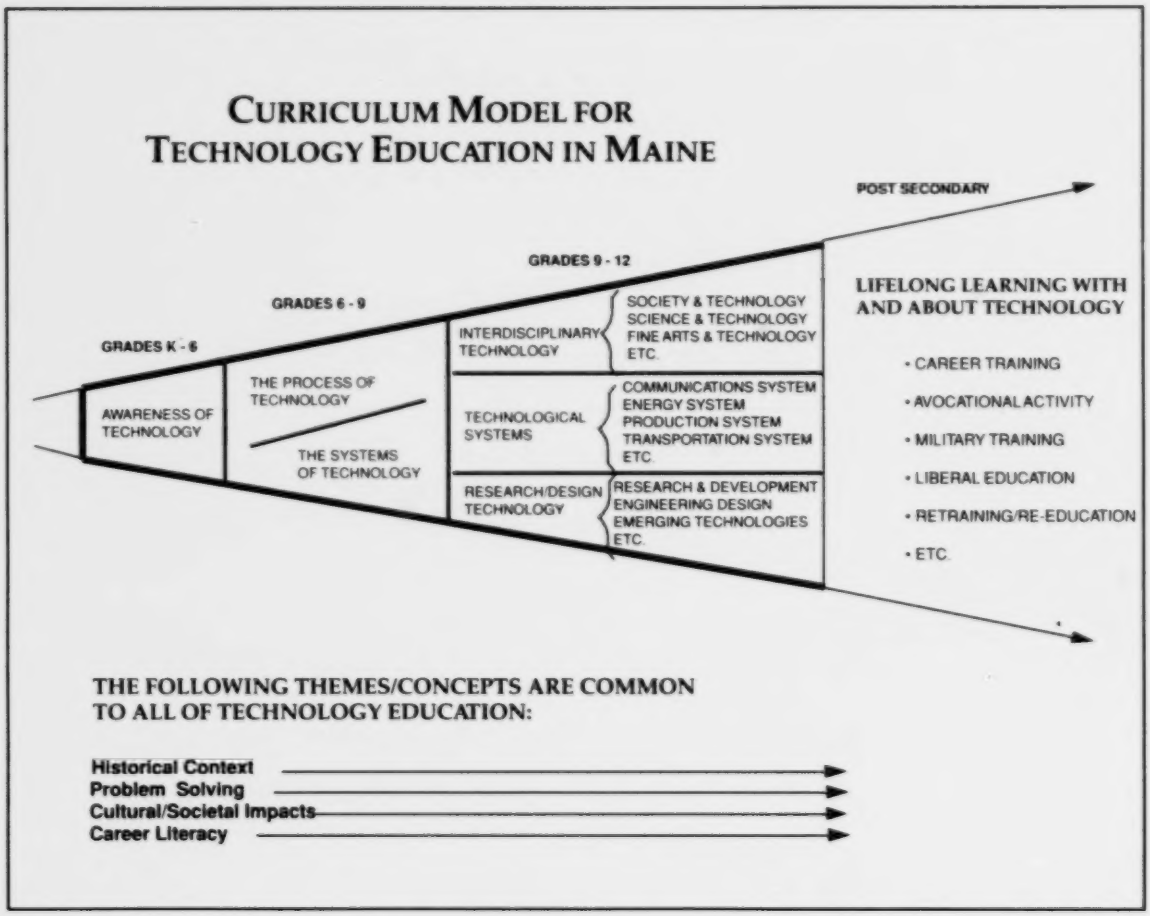


Figure 2: Curriculum Model for Technology Education

TECHNOLOGY AS PROCESS

Technology evolves from, and is, at its most basic levels, a process. To be truly technologically literate, students must understand and be somewhat skilled at applying the process. The process is the design process which exists in many variations and can be illustrated in many ways. Figure 3 is one such example and clearly illustrates how the technology process functions. A technological problem for solution is recognized. It progresses through a series of activities which are influenced by both resources and limiting factors. Finally a solution is reached, which inevitably creates new problems for which new solutions must be designed. Thus, the design of this model stresses the evolutionary aspect of the technological process.

The model presented here is general, and can be used both as a model for understanding design and as a model of the desired form of student activities. This model, although quite useful to educators, should not be considered complete or the only model. While other models may serve teachers as effectively, it is important that any model include the activities fundamental to problem solving.

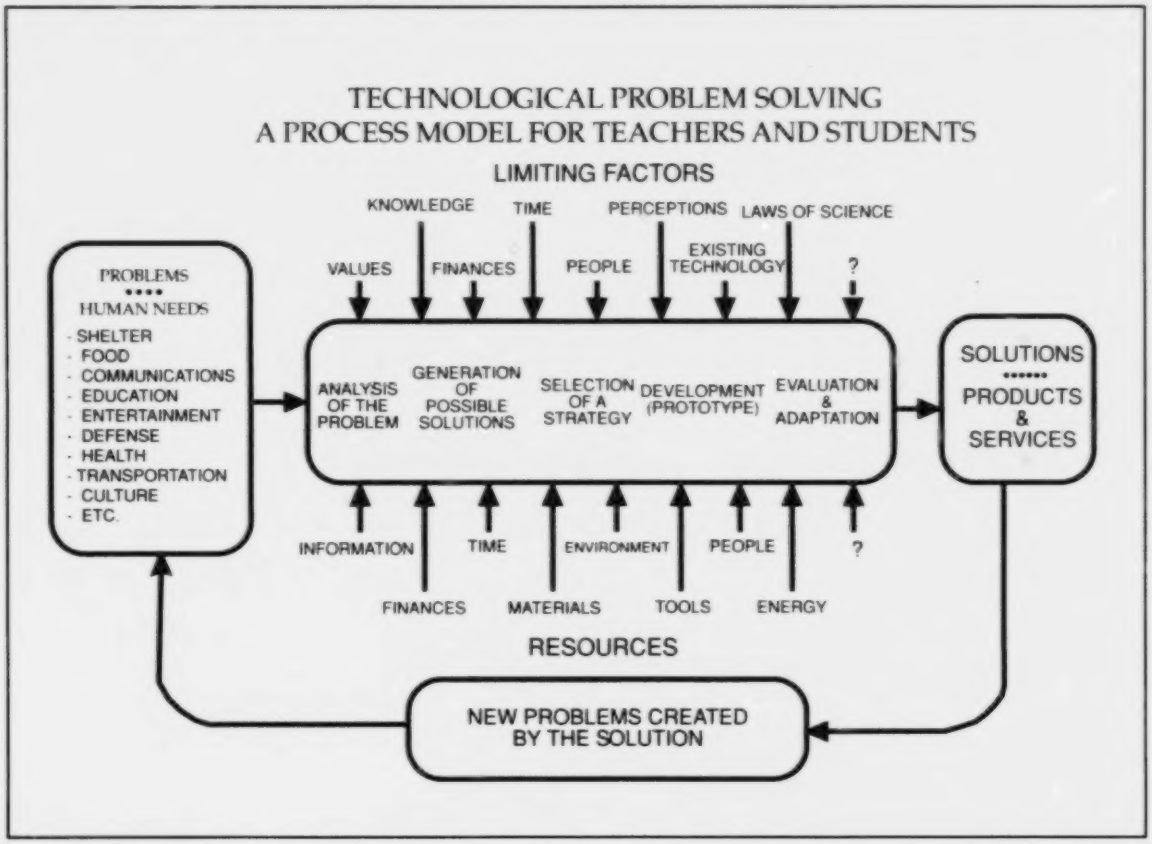


Figure 3: Technology Process Model
Based on a model by Marshall, A.R. (Ed.) (1974). School technology in action. London: English University Press. Ltd.

THE CONTENT OF TECHNOLOGY EDUCATION

Technology education, like all other disciplines, has an identifiable knowledge base as well as processes for creating (see technological problem-solving model, Figure 3) the knowledge within the discipline. The following diagram represents one way of modeling the basic areas that make up that knowledge base. The model facilitates the identification of related topics for the development of courses, units, lessons, and Technology Learning Activities (TLA's).

The model uses three axes to illustrate a body of knowledge that centers on the examination of broad technological systems at their various levels of development in terms of the relationships of their system components. It incorporates several of the characteristics that distinguish technology education from the previous craft and industrial based approaches. They are the study of integrated technological systems, their various levels of historic development, and those systems as they relate to the cultural, biological, and environmental systems with which they interact.

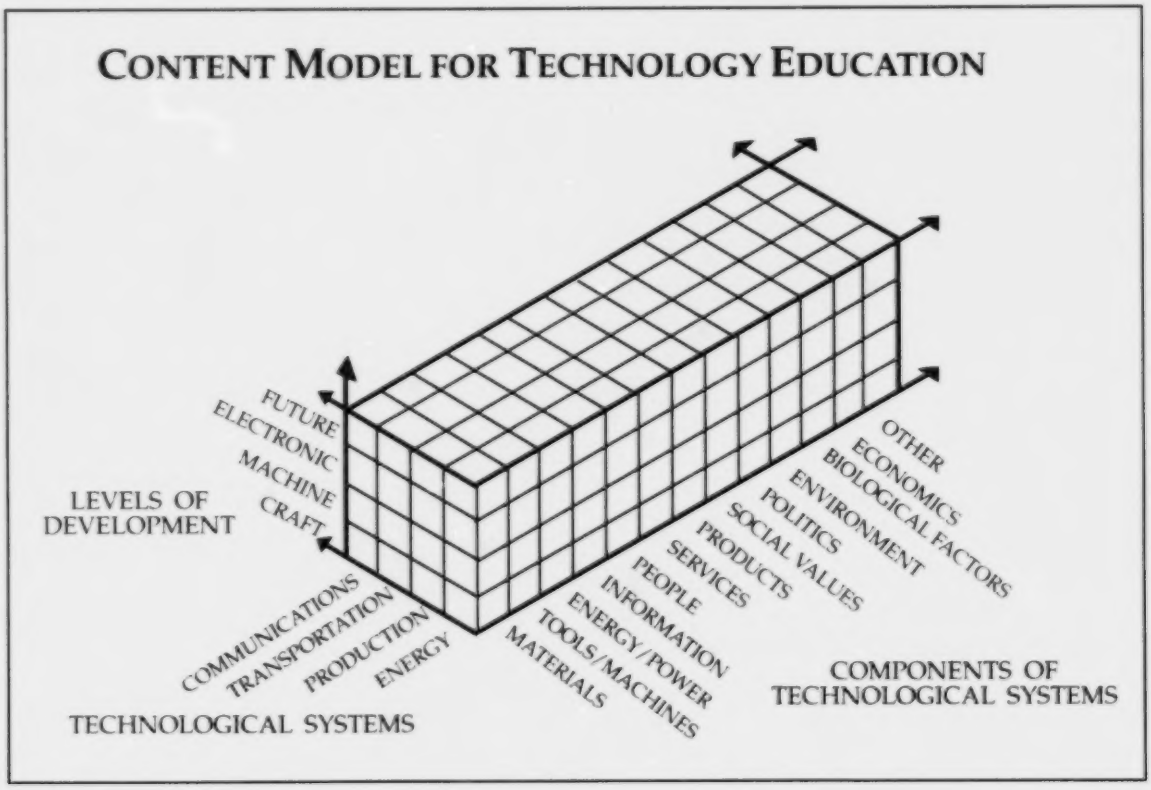


Figure 4: Content Model for Technology Education
Levels of development, systems, and components.
Based on a model by DeVore, P. (1980). Technology - an introduction.
Worcester, MA: Davis Publications

ELEMENTARY SCHOOL TECHNOLOGY EDUCATION — AWARENESS OF TECHNOLOGY

At the elementary school level simple concepts and problem solving skills are introduced that begin to develop an awareness and understanding of the role played by technology in the lives of the students. A properly designed elementary technology education curriculum encourages youngsters to think and to solve problems while engaged in manipulative activities. These experiences should include activities which can be integrated with other subjects being studied to support and reinforce the learning of the concepts being considered. These activities introduce and foster life-long learning skills, promote positive working relationships, and develop communication skills.

MIDDLE SCHOOL/ JUNIOR HIGH SCHOOL TECHNOLOGY EDUCATION — EXPLORING TECHNOLOGY

The specific study of technology as a discipline usually begins at the middle school and/or junior high school level. It is at this level that a basic understanding of the process of technology and the systems of technology is developed.

As the basis for most technology education activities, it is suggested that the process of technology be taught before the systems of technology are studied; and that a series of specifically designed Technology Learning Activities are used to develop systematic problem solving and design skills involving a variety of tools and materials.

Once these skills are acquired, they are used to explore the technological systems of communications, energy, production, and transportation through design problems that form the basis of the laboratory activities. There are sample outlines of these content areas included in the complete guide. In addition a growing number of excellent texts are available which can be effectively used in courses.

SENIOR HIGH SCHOOL TECHNOLOGY EDUCATION — APPLICATIONS OF TECHNOLOGY

At the senior high school level students select courses that meet their individual needs and interests as they begin to prepare for careers and/or higher education. The high school section of the curriculum model (Figure 2) suggests courses in three broad areas which focus on: interdisciplinary aspects of technology, specific technological systems, and research and design. The interdisciplinary courses build upon student interest in the social sciences and arts. Courses in this area may include the study of Technology and Society, Science and Technology, Photography: Art and Technology, Graphic Design, and Publishing Technology. The area labeled technological systems is an extension of the study of technological systems in middle school/junior high and is composed of courses that study those systems in greater detail and complexity. The third area is designed primarily for students who plan to pursue careers in technical areas such as engineering and technology and build an analytical base for further study. Courses in this area focus on research and development, engineering design, application of math and science, and emerging technologies.

TECHNOLOGY EDUCATION'S RELATIONSHIP TO SECONDARY VOCATIONAL EDUCATION — SPECIFIC APPLICATION OF TECHNOLOGY

Students in the last two years of their secondary school program are presented with many elective offerings from which to choose. Technology Education and Vocational Education are two of these many offerings which co-exist with advanced placement courses in mathematics and the sciences, advanced offerings in foreign language, business, home economics, and many others.

Technology Education has as its major goal the development of technological literacy for all students, regardless of their career choices and experiences. For a student who has not taken any high school technology education courses up to this point, this is an ideal time to start. A student who has elected previous technology education courses can use these two years to further his or her understanding of technological systems through problem solving activities that are more complex, and more closely associated with the world which they must soon face; or explore other areas of Technology Education.

The Vocational program has as its major focus the preparation of students for entry level employment in the business, industrial, or service sector. Its mission is to provide those individuals who desire and can profit from the program, the job-related understandings, skills, and attitudes essential for success.

While both Technology Education and Secondary Vocational Education deal with knowledge about technology and its impact on human beings and the environment, the similarity ends when the goals of the programs are examined and compared. Technology Education provides a general literacy about technology but does not provide the specific, job-related understandings, skills, and attitudes needed for employment in an identified occupation. Vocational Education, on the other hand, provides greater depth of understandings, skills and attitudes about technological issues in a much narrower subject area.

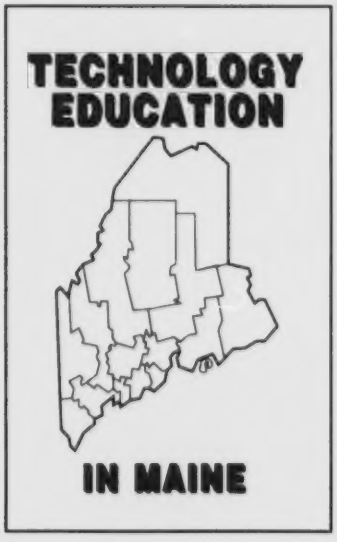
While there are definite differences in planned outcomes for students in secondary vocational programs and secondary technology education programs, it must be remembered that both areas provide a measure of technological literacy. In the interest of providing the best possible public education for the learner, cooperation between the two areas is essential.

TECHNOLOGY LEARNING ACTIVITIES (TLA'S)

The laboratory activities used to achieve the objectives of Technology Education are commonly described as Technology Learning Activities, or TLA's. TLA's are the primary methodology of Technology Education and are used to develop critical thinking, creative thinking, and problem solving skills needed to reinforce the technological system concepts studied. They are similar in many ways to the laboratory activities of industrial arts, but are different in that they focus more on research and the creative solutions to problems for which there are many variations of answers, and less on tool skill development and object making.

DISTINGUISHING CHARACTERISTICS OF TECHNOLOGY LEARNING ACTIVITIES (TLA'S)

1. Activities are either design or investigative problems, or skill development problems to prepare the students for higher level (problem solving) activities.
2. Activities focus as much as possible on the higher level activities.
3. Problem solving (design) methodology includes, in a variety of forms: problem definition, problem analysis, creative solution generation, development, and evaluation.
4. Problems should allow for a variety of creative solutions and problem solving methods.
5. Activities are a means to understanding technological systems, relationships to other disciplines and the development of problem solving skills.
6. Activities are relevant, interesting, and challenging to the learners.



TITLE: THE "AMERICA'S CUP" CHALLENGE

Design a wind-powered monohull vessel to travel a predetermined distance (by race officials) in the least amount of time.

OBJECTIVES:

The Student will:

1. Work cooperatively in a design team situation.
2. Generate ideas through brainstorming activities.
3. Develop positive attitudes while working in a competitive atmosphere.
4. Work in a creative and critical thinking situation.

MATERIALS & RESOURCES:

Materials for this problem should not be limited to what is available within the lab - they should be unlimited. Students should be encouraged to scrounge for parts, materials, or supplies and be resourceful in their use.

LIMITATIONS:

- Cost of materials not to exceed $ 5.00.
- Length of vessel is not to exceed nine inches. (including bow sprit)
- The beam may not exceed one-half of the length of the vessel.
- Maximum sail area = 80 square inches.
- Test area of water will be at least 12 inches wide and 6 inches deep.
- Must have asthetic appeal.
- Time limit for completion: 6 days with testing on the 6th day.
- Crew size: three people.
- Vessel must be wind powered only.
- Include a spec sheet with the following data: LWL, LOA, Displacement, Sail Area, Mast Height, & Draft.
- Group must choose a country capable of challenging the America's Cup.

PROCEDURES:

- Form a racing team to consist of a "Captain" and two "Crew" members.
- The vessel will represent a financially capable country other than the United States.
- The vessel must be named in the language of the country represented.
- The vessel must fly the flag of the country represented.
- Prepare two types of reports (one oral and one written) which include the following information:

A. Country Information in folder form

1. Location of capital by latitude & longitude coordinates - pointed out on a globe or chart.
2. Flag colors & design on the boat and folder.
3. Population
4. Imports/Exports
5. Capital
6. Language
7. Climate
8. Type of government

B. Drawing and explanation of the type of hull design you chose.
   - Reason you chose that particular design
C. Drawing and explanation of the rigging
   - Why did you chose the rigging
D. List of materials used and why you chose those materials.
E. Completed specification sheet
F. Completed terminology sheet

EVALUATION:

Vessel which travels from point A to B in shortest time.	50 Points
Vessels with 75% of fastest time	25 "
Vessels with 25% of fastest time	10 "
Vessels with most asthetic appeal (By vote of class)	25 "
Vessels with best hull design (By analysis & vote of class)	25 "
Vessels with best deployment of sail area.	25 "
Attention to detail.	10 "
Spec Sheet.	24 "

(To qualify for an extra 50 points your group must do an oral class report on the country that you represent)

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

Teacher may develop a test tank suitable for testing the vessels. This tank should be a minimum of 6" deep, 12" wide, and 8 feet long.

NAUTICAL TERMINOLOGY:

LOA = Length over all
LWL = Length at the water line
Displacement = The weight of the vessel
Beam = Distance across the width of the vessel at widest point
Draft = Amount of water vessel draws from water line to bottom of keel
Rudder = Steering mechanism

SUBMITTED BY:

Rob Cronk ..... Wiscasset High School
Fred Lewis ..... Boothbay Region High School
Clive Farrin ..... Boothbay Region High School
Bill Carney ..... Poland Community School
Paul Johnston ..... Elm Street School, Mechanic Falls
Phil Merril ..... Rumford JR/SR High School

ADDITIONAL RESOURCES

International Technology Education Association (ITEA)
1914 Association Drive
Reston, Virginia 22091-1502
(703) 860-2100

Technology Education Association of Maine (TEAM)
c/o State Technology Education Consultant
(address below)

A list of additional resource people and organizations can be obtained by contacting:
Dr. Ed W. Taylor
Technology Education Consultant
Maine Department of Education
State House Station #23
Augusta, Maine 04333
(207) 289-5854

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School of Applied Science
Department of Technology
Gorham, Maine 04038
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The Information Exchange - Division of the Maine State Library
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Vocational Curriculum Resource Center of Maine
KVVTI
P.O. Box 29
Fairfield, Maine 04937
(207) 453-9762 ext. 170

Maine technology education teachers may obtain copies of the complete ***Technology Education Curriculum Guide for the State of Maine*** by attending training sessions held throughout the state.

Out of state requests should go through the office of specific state technology education consultants, where a copy of the guide iis on file or contact the Technology Bank through ITEA .

John R. McKernan, Jr.
Governor

Eve M. Bither
Commissioner

DEPARTMENT OF EDUCATION

Telephone (207) 289-5800

May 22, 1990

To the Reader:

As Maine prepares to enter the twenty-first century, parents, educators, and all of society need to address the question, "What will today's students need to know tomorrow?" Recently, our world has experienced dramatic changes and the rate of change will continue to accelerate in the future. The driving force behind this change is technology. We are becoming better and more efficient at what we do, the time it takes has been reduced, and the results of our actions influence people and events around the world. For this reason, it is of paramount importance that tomorrow's leaders receive training today that will enable them to understand and manage technology wisely.

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Sincerely,

Eve M. Bither

Eve M. Bither
Commissioner

State House Station 23, Augusta, Maine 04333 — *Offices Located at* the Education Building

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STATE OF MAINE
OFFICE OF THE GOVERNOR
AUGUSTA, MAINE
04333

JOHN R. MCKERNAN, JR.
GOVERNOR

June 7, 1990

Dear Educators,

Maine's future depends on its greatest natural resource, its people. We are a proud state and a proud people who have used our collective wisdom to develop a vibrant economy while maintaining our environment.

In order for the people of our state to maintain the quality of life we so enjoy, it would be imperative that we broaden basic educational skill levels to assure that graduates of Maine's schools not only possess a fundamental knowledge base but have the capacity to implement these skills in a rapidly changing workforce and society. Technology education is an essential component of this knowledge base, and it will help bring relevance to learning and an understanding of the environment in which we live.

Assistant Secretary of Education, Betsy Brand, in her remarks to the American Vocational Association's Annual Conference in December of 1989, stated, "The needs of today and tomorrow in technical education should direct our actions, not the traditions of the past..." This technology education curriculum guide offers a multitude of opportunities to meet our needs in developing the knowledge, skills, and values to live and work in a technologically advanced society.

I would like to offer my personal thanks to the many individuals who contributed to the creation of this document, and invite the readers to utilize this document in their pursuit of excellence in technology education.

Sincerely,

John R. McKernan, Jr.
Governor

JRM/mpm

PRINTED ON RECYCLED PAPER

FOREWORD

"The world today is fast changing. We are in the middle of a technological era in which the level of sophistication of tomorrow's workers will play an increasingly greater role. Technological literacy is vital if we are to continue to grow as a nation. I fully support and admire your efforts to upgrade the industrial arts curriculum to assist students in making the transition between the types of skills needed for earlier decades and the types of skills that will be needed in the year 2000 and beyond."

Senator George J. Mitchell

"I am pleased to contribute my thoughts to the Curriculum Guide prepared by the Technology Education Association of Maine (T.E.A.M.) in conjunction with the University of Southern Maine and the State Department of Education. As Maine enters the 21st Century, a technologically literate population will be essential to our economic growth and the success of our democratic institutions. The economic future of our State depends on a well-trained work force which can respond to challenges effectively. Technology has an increasingly significant effect on our lives and our citizens will need a complete understanding of its implications in order to make informed decisions. By educating our young people to be technologically literate, school administrators, teachers, and parents are doing a tremendous and vital service to Maine and the Nation."

Senator William S. Cohen

The statements from our two senators provide an excellent point of departure in introducing the readers to the efforts put forth in preparing this Curriculum Guide. A wide ranging Committee of teachers, administrators and teacher educators deliberated long and hard to arrive at its content not only to update teachers in the classroom on the concepts and challenges of Technology Education, but also to provide direction for its implementation at all levels of education from the elementary through the high school.

Technology Education, formerly Industrial Arts, has given new meaning to education for technological literacy. It has evolved from a program which was first introduced to provide children and youth with an opportunity to explore their manipulative talents, to discover and identify possible career choices, and to learn more about the industrial complex which affected their lives. Past curriculum guides provided teachers with detailed content analyses that responded to the needs dictated at that time.

As the country moves from an industrial society to one dominated by information, the decline in manufacturing and the growth of human services is impacting on all society. The advent of high technology, computers, lasers, and robotics, to mention a few, and increasing competition from abroad have resulted in a re-examination of public school curriculums and restructuring efforts to correct deficiencies and to raise educational levels and standards. The basic education of all students is being redirected and strengthened. Standards for promotion and graduation are being raised and the concern for the quality of learning and understanding has reached a new high.

It is interesting, however, that in the race to prepare youth for a highly technological society, the curriculum area which is designed to provide these youth with the skills, understandings and attitudes essential for their success in that society has been given limited consideration in the total school curriculum. Further, with the ever-increasing and evolving technology, the need for additional highly skilled technical personnel

has become even more pressing. The technical colleges whose goals are to prepare their graduates for gainful employment, find their mission hampered by entering students whose career choices have been made without prior knowledge or understanding. Similarly, the business and industrial firms employ with reluctance the graduate whose academic preparation may be adequate, but woefully lacking in technological literacy.

Technology Education, then, must be a vital part of the general education of all children and youth. It makes elementary children aware of the technology which virtually dictates their every move. It introduces middle school students to the processes and products of human endevor and the systems through which they are realized. It opens new vistas to high school students by providing a greater depth of understanding of technological opportunities and practices and ignites the path to challenging careers. At all levels, Technology Education encourages learners to express their creativity and ability to solve technical and environmental problems; to develop conceptual skills and experiences in research and development processes in an activity oriented setting.

In the common curriculum core in which mathematics, the sciences, the arts, languages and other disciplines are required, understanding of the desired concepts and outcomes, when merged with those of Technology Education, will be more readily achieved by the students when studied or examined in a laboratory environment. Not only will there be greater incentive for learning but teacher and student alike will find the experiences exciting and rewarding.

This Guide provides content and method for implementing Technology Education at all levels of education. It will open doors to a new direction for all learners to enter the world of the "technologically literate."

Dr. John Mitchell,
Professor Emeritus
University of Southern Maine

This Technology Education Curriculum Guide marks both a reaffirmation and a new beginning. It is a reaffirmation of the industry, hard work, and new ideas which have characterized the Industrial Arts profession in Maine and it is a new beginning for Technology Education in Maine. It is the first complete curriculum guide in quite some time and has only come about with much labor on the part of the individuals listed elsewhere in this document. The technology teachers of Maine can be rightfully proud of this project because it represents the excellent work of professionals throughout Maine. During the committee's work, the ideas and expertise of the University of Southern Maine, State Department, and the International Technology Education Association, were combined with those of the classroom to produce this guide. This effort was supported by a grant from funds supplied by PL98-524, the Carl D. Perkins Vocational Education Act of 1984. I believe it is an excellent guide for Maine and I suspect it will help other professional educators as they strive to provide technological literacy for learners who will live and work in the twenty-first century.

Dr. Ed W. Taylor,
Technology Education Consultant
Maine Department of Educational and Cultural Services

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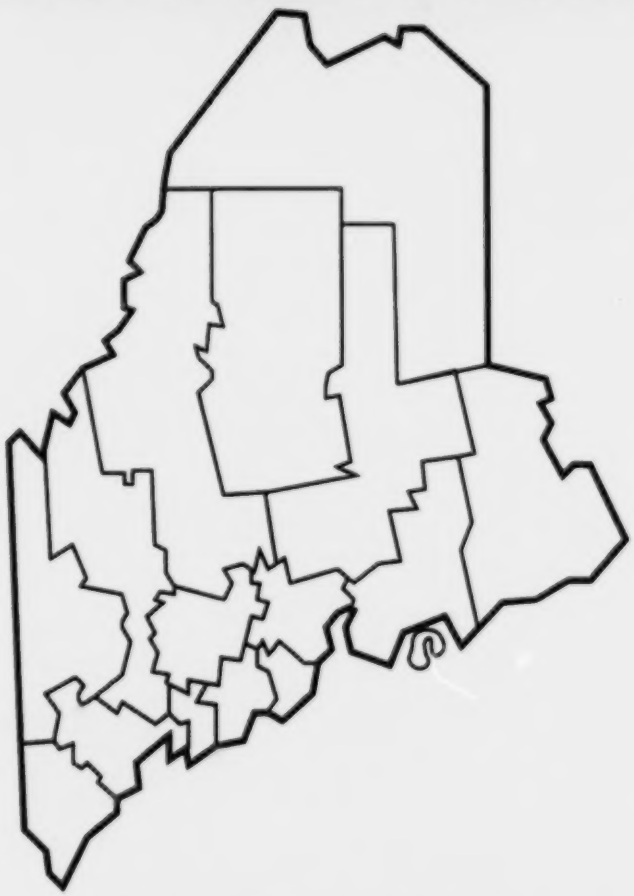
TECHNOLOGY EDUCATION



IN MAINE

INTRODUCTION

INTRODUCTION

In May of 1987, the Executive Board of the Technology Education Association of Maine (TEAM) applied for a Carl D. Perkins grant through the Bureau of Vocational Education, Department of Education and Cultural Services, Augusta, Maine. This Technology Education Curriculum Guide for the State of Maine is the product of that grant and represents countless hours of work by members of TEAM and representatives from both the Department of Technology at the University of Southern Maine and the Department of Education and Cultural Services. The purpose of this guide is to assist the profession as it makes the transition from industrial arts education to technology education. It provides a definition and description of the type of education that is necessary for the future citizens of Maine to successfully benefit from, contribute to, and evaluate the technological society in which they live.

Unlike previous Maine curriculum guides, this document is neither a "cookbook" nor an attempt to define the specific nature of individual programs. It does, however, present basic definitions, models, and examples that will provide a framework which individual instructors can use to construct their own units, courses, and curriculums. With this thought in mind, the reader needs to realize, that this guide is intended to be both flexible and constantly evolving.

It is anticipated that as specific curriculum materials are developed, they will be disseminated to add to the growing body of materials available for Technology Education. These materials may include texts, other state curriculum guides, materials from the International Technology Education Association, and Technology Learning Activities. As these become available, teachers are encouraged to modify them to meet local needs. The loose-leaf format is intended to encourage these additions, as well as the inclusion of teacher generated material.

The guide is divided into four distinct but interrelated sections:

I. **Technology Education Explained**
II. **Process of Technology Education**
III. **Content of Technology Education**
IV. **Technology Learning Activities**

It should be pointed out that not only is the curriculum evolving, but the process of delivery is changing and becoming part of the content.

It is envisioned that this activity based education will develop an understanding of the systems of technology in their historical, cultural, and environmental contexts, while developing creative thinking, critical evaluation and problem solving skills. Technology Education is a discipline that is evolving and promises to meet the emerging needs of society.

John L. Kraljic

John L. Kraljic

Curriculum Guide Committee Chairman

On the following page is a list of the people who served on the TEAM curriculum grant committee. I would like to thank each of them for all of their efforts and hard work to make this first State of Maine Technology Education Curriculum Guide possible. J.K.

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THE EVOLUTION OF TECHNOLOGY EDUCATION

Since early in this century, the field of industrial education (industrial arts and secondary vocational education) has made major contributions to millions of students as they have studied their technical heritage and have prepared for the world of work. Its content base dealt with the tools, materials, processes, and occupations associated with the industrial growth and progress our country has made from its inception into the 1950's. It was during the decade of the 1950's that a new era began to evolve - the Electronic Age - characterized by computers, microprocessors, telecommunications, biotechnology, and others. These innovations have had a dramatic effect on our culture and environment and it has become obvious that the industrial education of the past is no longer adequate. Consequently it has become necessary to re-examine the content base and process used to develop technological literacy for all citizens.

As that examination progressed, industrial education expanded the scope and sequence of course offerings to emphasize current and emerging technology and methodology appropriate for the twenty-first century. Thus, a new name and image were created — TECHNOLOGY EDUCATION. In promoting this new movement, the industrial arts profession changed the name of its international association in 1985 from The American Industrial Arts Association (AIAA) to the International Technology Education Association (ITEA). Since then, numerous state affiliates, school systems, and universities have changed their programs and produced curriculum guides to focus on technology education.

To assist the profession in its transition, the International Technology Education Association (1985) offers the following definition of technology education:

> **"TECHNOLOGY EDUCATION IS A COMPREHENSIVE ACTION-BASED EDUCATIONAL PROGRAM CONCERNED WITH TECHNICAL MEANS, THEIR EVOLUTION, UTILIZATION AND SIGNIFICANCE; WITH INDUSTRY, ITS ORGANIZATION, PERSONNEL, SYSTEMS, TECHNIQUES, RESOURCES AND PRODUCTS; AND THEIR SOCIAL/CULTURAL IMPACT"**

With this definition the International Technology Education Association supports the notion that the primary goal of today's school is to prepare youth for the world in which they live. This enables them to enter the "real world" when they leave formal education, prepared to become contributing, knowledgeable and successful members of our technological society.

The movement to technology education has been an evolutionary one that has built on programs of the past. Some of the basic content of previous approaches remains a part of technology education, but its emphasis has been changed to introduce a wider scope and direction. Figure 1 shows that technology education has evolved from the focus of industrial arts which had been built on industrial and craft skills to one where the thrust has shifted to the study of systems; those systems in their historical context; the relationship of technological activity to the environment; and an increased emphasis on interdisciplinary study and problem solving.

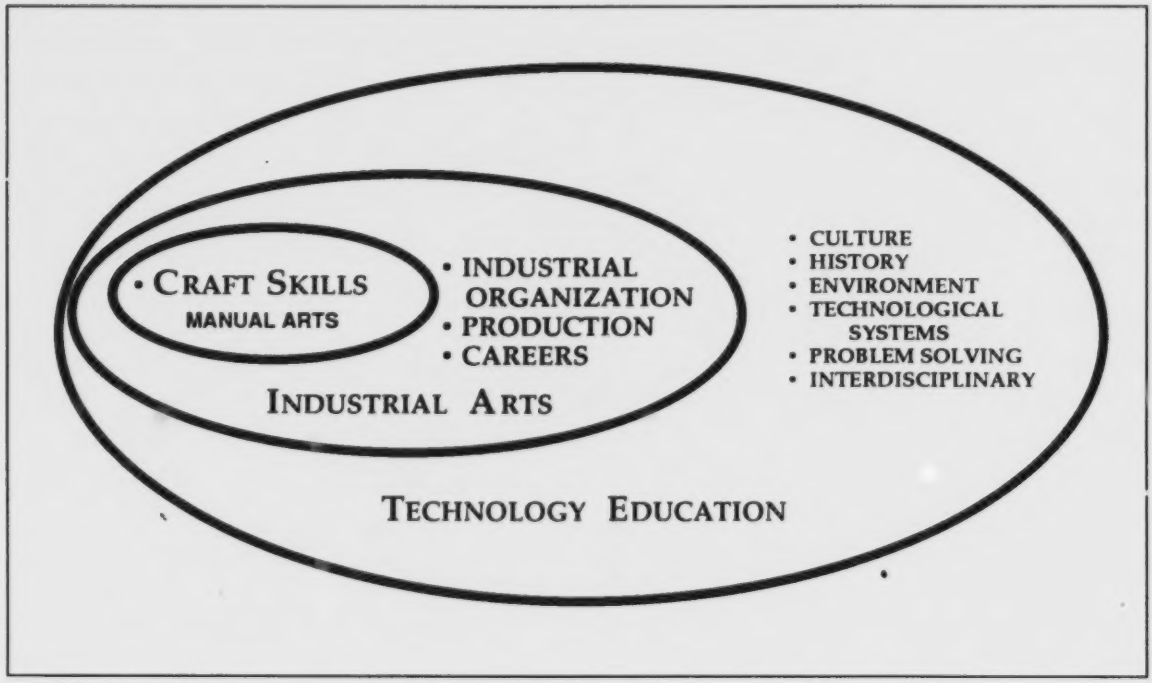


Figure 1: Evolution of Technology Education

TECHNOLOGY DEFINED

To be consistent with the broad systems approach of technology education, technology itself must be broadly defined but must still retain its uniqueness from other areas of human activity. For the purposes of Technology Education in Maine, technology is defined as:

> **HUMAN ACTIVITY WHICH SOLVES PROBLEMS AND EXTENDS CAPABILITIES THROUGH THE MANIPULATION AND CONTROL OF THE ENVIRONMENT USING KNOWLEDGE, CREATIVITY, AND RESOURCES.**

Technology then, is a uniquely human activity which is used to solve problems and extend capabilities through the manipulation of the environment. It differs from the closely related area of science which has as its purpose the understanding of natural phenomenon, and not its control and manipulation. In addition, technology is not *hardware*, such as cars, airplanes, computers, or robots; these examples of hardware are *solutions* to specific problems, i.e. the results or products of technology. Understanding technology requires examining the solutions, their design, evolution, and impacts.

TECHNOLOGY EDUCATION DEFINED

Technology education can be defined as:

> **THE ACTION-BASED DISCIPLINE DEVOTED TO THE APPLICATION OF HUMAN ACTIVITY TO SOLVE PROBLEMS AND EXTEND CAPABILITIES THROUGH THE MANIPULATION AND CONTROL OF THE ENVIRONMENT USING KNOWLEDGE, CREATIVITY, AND RESOURCES.**

Technology Education is education about technology - its processes, evolution, systems, resources, limiting factors, impacts, products, and problems - in its cultural, environmental, and historical context. Through problem solving processes and Technology Learning Activities, students will research, study, create, and evaluate devices. As a result of Technology Education students will better understand the world in which they live and be better prepared for the future.

MISSION OF TECHNOLOGY EDUCATION

> **IT IS THE MISSION OF TECHNOLOGY EDUCATION TO ADVANCE TECHNOLOGICAL LITERACY AT ALL LEVELS, AND PREPARE OUR CITIZENRY TO LIVE IN AND CONTRIBUTE TO OUR TECHNOLOGICALLY-BASED SOCIETY.**

GOALS AND OBJECTIVES OF TECHNOLOGY EDUCATION

The goal of Technology Education is to produce a technologically literate society.

Students develop technological literacy necessary for global survival through the research, design and solution of "real-world" technical problems. As students investigate these relevant problems in activity-based laboratories, they learn about the history and impact of the different technological systems in which the problems are found. It is through further study of these systems that the learner understands the development of systems, components and their interrelationships. This helps him or her realize that action on one part of the system has "real-world" consequences elsewhere. Interdisciplinary activities provide an example of this interrelatedness within the educational system.

"Hands-on/minds-on", developmentally appropriate, problem-solving activities nurture the formal thinking skills that are required by the citizenry of the twenty-first century. This cognitive growth is accompanied by development of the social skills necessary to work with others in a task-oriented environment.

As a result of the wide variety of laboratory experiences in technology education, students will develop:

1. An understanding of technological systems in terms of their history, evolution, organization, components, occupations, contexts, and scientific principles.

2. An understanding of the interrelatedness of technology and the sciences, mathematics, language arts, history, social studies, and fine arts.

3. Career awareness through an understanding of individual skills and interests as they relate to the technologies used by various occupations.

4. Critical thinking skills necessary to evaluate technology and its products in their environmental, cultural, and individual contexts.

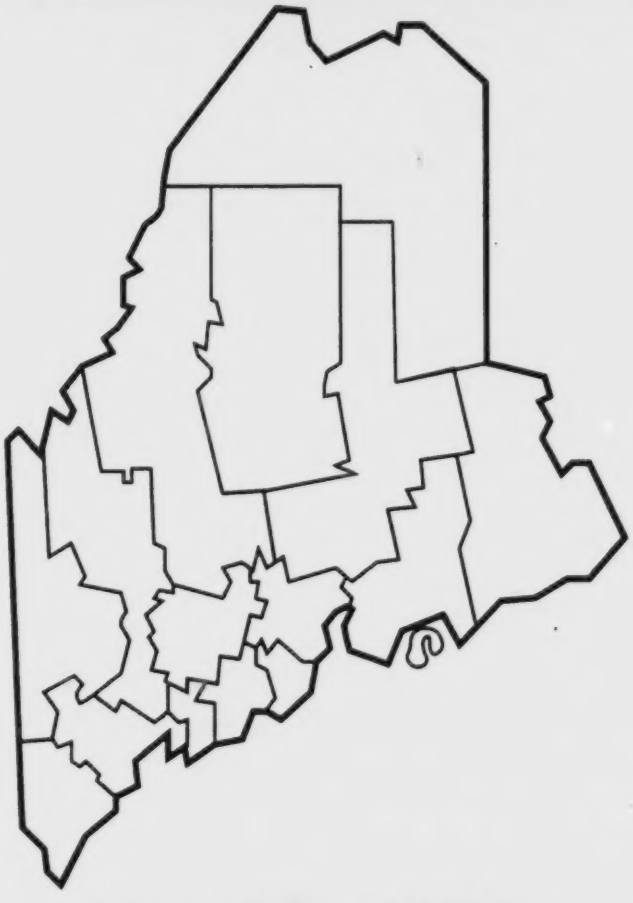
5. Creative problem solving skills necessary to identify, develop, implement, and evaluate solutions to technological problems.

6. Basic skills in the safe use of tools, materials, and processes of technology.

7. An attitude of responsibility for the effects of technology on the environment, culture, and individual.

8. Desirable social skills such as cooperation, self-confidence, leadership, and tact.

TECHNOLOGY EDUCATION



IN MAINE

SECTION II
TECHNOLOGY AS PROCESS

TECHNOLOGY AS PROCESS

Technology evolves from, and is, at its most basic levels, a process. To be truly technically literate, students must understand and be somewhat skilled at applying the process. The process is the design process which exists in many variations and can be illustrated in many ways. Figure 2 is one such example and clearly illustrates how the technology process functions. A technological problem is recognized. It progresses through a series of activities which are influenced by both resources and limiting factors. Finally a solution is reached, which inevitably creates new problems for which new solutions must be designed. Thus, the design of this model stresses the evolutionary aspect of the technological process.

The model presented here is general, and can be used both as a model for understanding design and as a model of the desired form of student activities. This model, although quite useful to educators, should not be considered complete or the only model. While other models may serve teachers as effectively, it is important that they include the activities fundamental to problem solving.

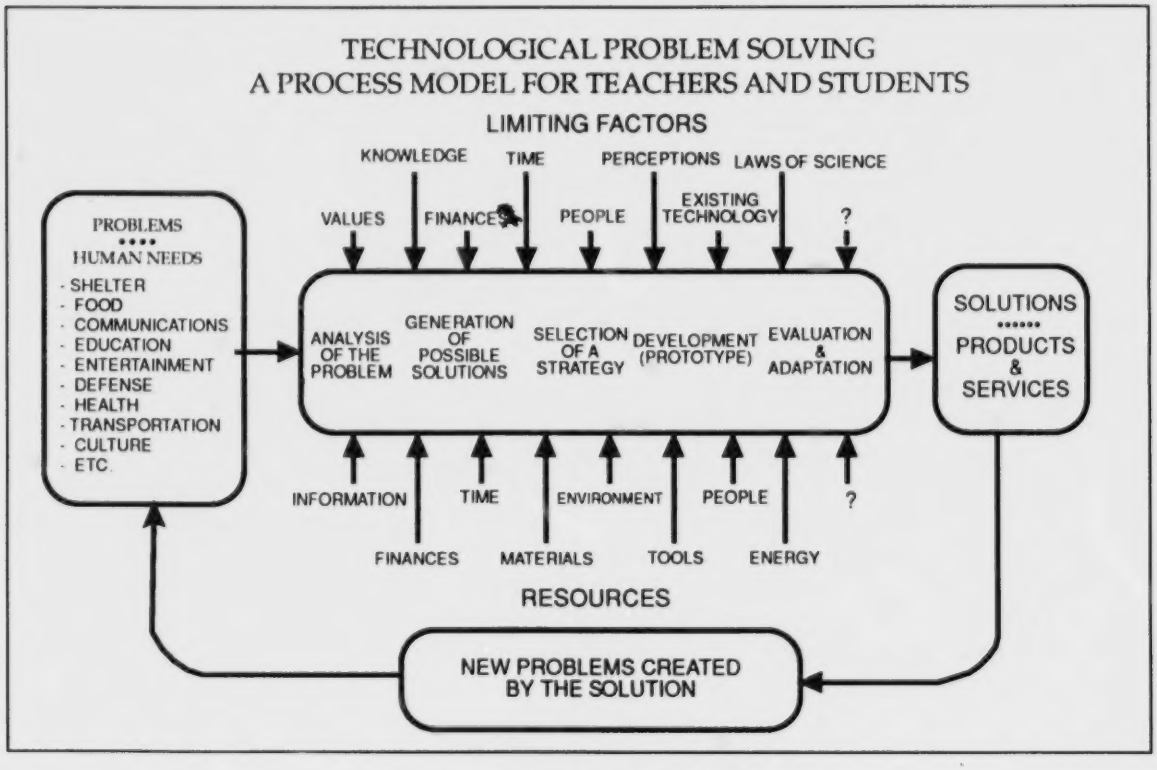


Figure 2: Technology Process Model

Based on a model by Marshall, A.R. (Ed.) (1974). School technology in action. London: English University Press, Ltd.

A Curriculum Model for Technology Education

Technology Education should consist of a sequence of courses from middle school through senior high school with technology education activities in the elementary schools being integrated into the regular curriculum. The activities and courses should progress from awareness building experiences in the early grades through high level technical problem solving experiences at the upper grade levels. There are many variations of the specific form such curriculums may take, and it is expected that they will be adapted to the various schools, laboratories, and student abilities and interests found in Maine. The model shown in Figure 3 is consistent with the vision presented in this guide, and with the Technology Education movement nation wide. The titles in the various sections are not suggested as specific course titles, but as descriptors of the focus at that level. The arrows show that a focus on the historical context of technology, problem solving, cultural and societal impacts, and career literacy should be an integral part of courses at all levels.

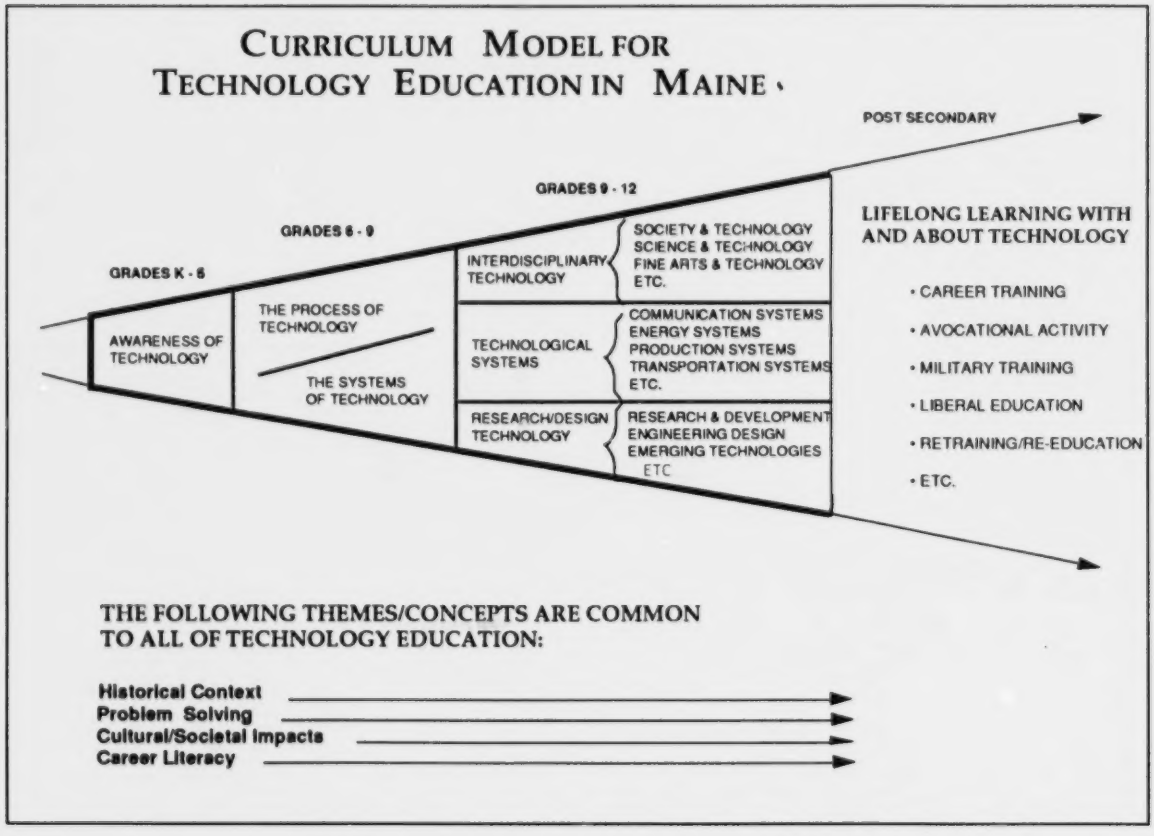
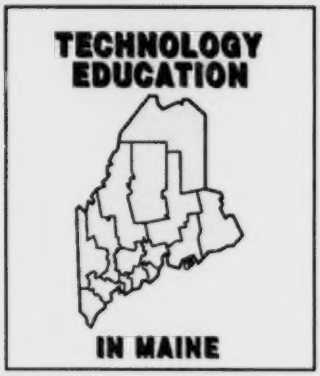


Figure 3: Curriculum Model for Technology Education

STUDENT POPULATION SERVED

Technology Education is a vital area of study for all students: gifted and talented, general, special needs, disadvantaged, at risk, or those in other classifications - regardless of their race, sex, color, national origin, religion, marital status, age or handicap. They will all have the opportunity for active involvement in the decisions and the creation of technology, which will influence their daily lives and contribute to their well being and success.



ELEMENTARY SCHOOL AWARENESS OF TECHNOLOGY

RATIONALE

A critical question arises as we are faced with the educational challenge of preparing today's youth for their future in a technological world:

When do we begin to expose young learners to the topic of technology?

The answer - as early as possible in the school curriculum . . . in our elementary schools. The elementary school is the ideal level to begin the development of an understanding of the technological world. Children need to become aware of the important role they will play as consumers, managers of technology, workers in a "high-tech" society, and caretakers of our environment.

Richard Paterson (1986) stressed the need for including this area of study in the elementary school setting in Implementing Technology Education: "The elementary school level is where the development of an essential understanding of technology should begin. Technology constitutes a universal element within all cultures and provides an important requisite for cultural survival" (p. 47).

Technology learning activities in the elementary program are usually included as a part of the on-going elementary curriculum. The elementary school teacher, supported by technology educators, is the primary manager of these activities which may take place within the classroom environment and do not usually require the use of highly specialized tools and machines.

Elementary School Goals

While engaged in technology learning activities, elementary pupils will develop:

1. An understanding of fundamental technology concepts and know that people create technology to control their environment.

2. A better understanding of concepts in math, science and other subject areas as a result of related hands-on technology activities.

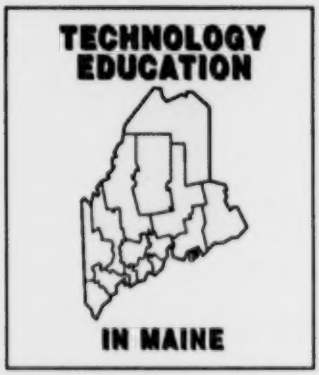
3. Increased self-confidence and positive attitudes through concrete accomplishments.

4. Basic skills and safe working habits while applying tools, materials, and processes to solve technological problems.

5. Technological awareness through activities introducing creative thinking, critical thinking, and problem solving.

Content

At the elementary school level simple concepts and problem solving skills are introduced that begin to develop an awareness and understanding of the role played by technology in the lives of the students. A properly designed elementary technology education curriculum encourages youngsters to think and to solve problems while engaged in manipulative activities. These experiences should include activities which are easily integrated with other subjects. This supports and reinforces the learning of concepts under study. These activities introduce and foster life-long learning skills, promote positive working relationships, and develop communication skills.



MIDDLE SCHOOL/ JUNIOR HIGH EXPLORING TECHNOLOGY

RATIONALE

As our world becomes more "technological", it is more and more important that the educational system produces graduates that are technologically literate. A look at school systems in the State of Maine that offer a technology course at the middle school/junior high level, shows that for the majority of the students, this is their first and only exposure to such a course in all their years of public education. For this reason, it is of paramount importance that:

A. All school districts should offer Technology Education programs to all of their students for a minimum of one full year or its equivalent at the middle school/ junior high level.

B. The individual(s) planning and conducting these programs realize(s) that this is the only exposure to formal Technology Education that the students may receive.

C. These programs are of the highest possible quality; challenging students to become creative and critical thinkers, arming them with problem solving skills and preparing them to live in an ever increasingly technological world.

D. Technology Education is an integral part of the middle school/junior high curriculum and is exploratory, activity based, and can be readily integrated with other subjects.

MIDDLE/JUNIOR HIGH SCHOOL GOALS

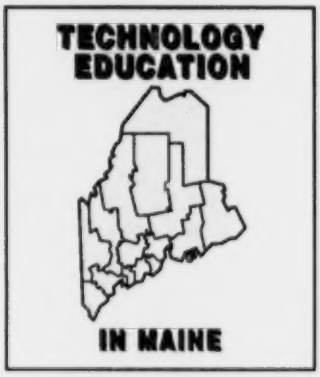
While engaged in technology learning activities, middle school/junior high school students will:

1. Apply creative and critical thinking skills while solving real problems.
2. Demonstrate an understanding of the nature of technological systems, as well as the historical, contemporary and future impacts of technology on our society.
3. Apply the resources of technology safely and efficiently.
4. Explore and integrate material from various curriculum areas.
5. Strengthen creative abilities and increase self esteem.
6. Discover and develop personal interests and abilities related to a wide variety of careers and avocations.
7. Develop social skills while working with others as members of a team.

CONTENT

The specific study of technology as a discipline usually begins at the middle school / junior high school level. It is at this level that a basic understanding of the process of technology and the systems of technology is developed.

It is suggested that the *process* of technology (problem solving) be taught before the technological *systems* are introduced. A series of specifically designed Technology Learning Activities should be used to develop systematic problem solving and design skills which involve the use of a variety of tools and materials. Once these skills are acquired, they are used to explore the technological systems of communications, energy, production, and transportation through design problems that form the basis of the laboratory activities. Sample outlines of these content areas are included in this guide. In addition, a growing number of excellent texts are available which can be effectively used in courses.



SENIOR HIGH SCHOOL APPLICATIONS OF TECHNOLOGY

RATIONALE

Technology Education at the high school level provides challenging activities based on contemporary technological systems. This subject area is designed to broaden the students' knowledge in areas of their interest, to prepare them to solve many of the technological problems they will face in the future, and to prepare them for higher education in technical or related fields.

SENIOR HIGH SCHOOL GOALS

While engaged in technology learning activities, high school students will:

1. Investigate careers and educational programs in technology and related areas.
2. Seek solutions to technological problems through research, design, development, testing, and experimentation.
3. Evaluate the issues and impacts of technology on the individual, the enviroment, and society.
4. Explore the technological systems from a historical, contemporary, and futuristic perspective.
5. Develop technical problem solving skills through the application of concepts from various content areas and other resources to real life situations.
6. Use the resources of technology safely and efficiently.

CONTENT

At the senior high school level students select courses that meet their individual needs and interests as they begin to prepare for careers and/or higher education. The excerpt of the curriculum model (Figure 3a) suggests courses in three broad areas which focus on interdisciplinary aspects of technology, specific technological systems, and research and design. The interdisciplinary courses build upon student interest in the social sciences and arts. Courses in this area may include the study of Technology and Society, Science and Technology, Photography, Art and Technology, Graphic Design, and Publishing Technology. The area labeled technological systems is an extension of the study of technological systems in middle school/junior high and is composed of courses that study those systems in greater detail and complexity. The third area is designed primarily for students who plan to pursue careers in technical areas such as engineering and technology and build an analytical base for further study. Courses in this area focus on research and development, engineering design, application of math and science, and emerging technologies.

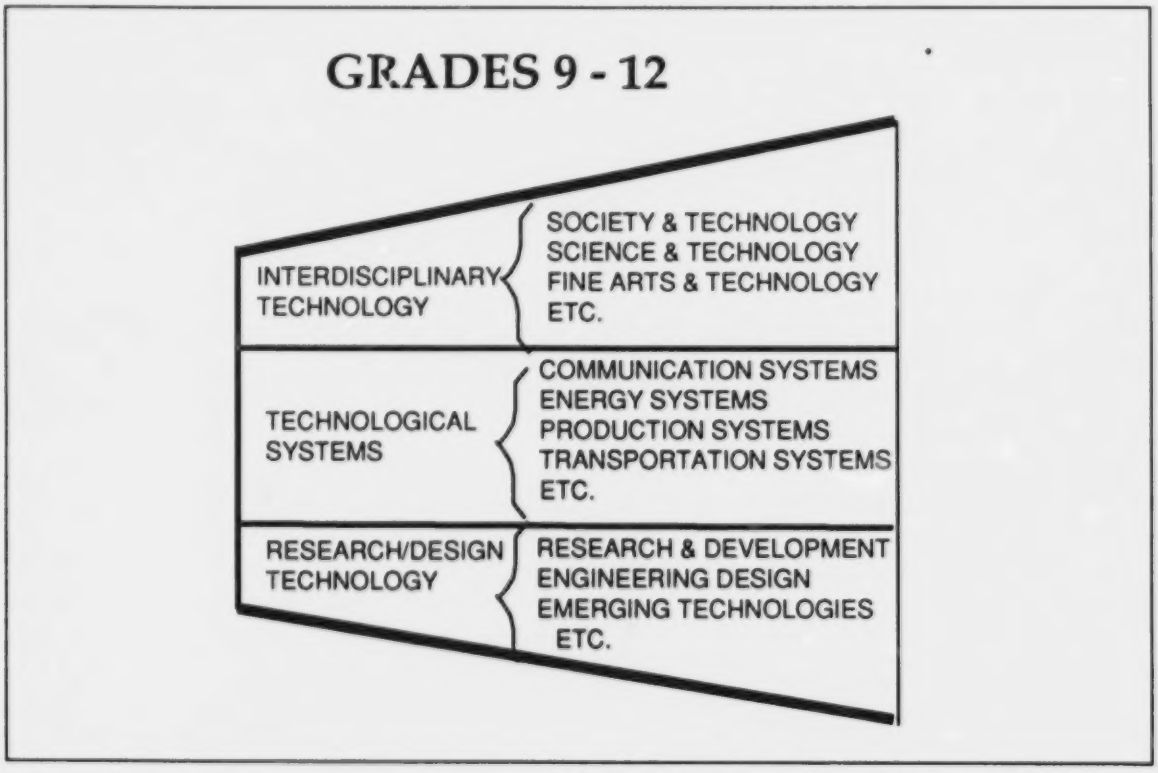


Figure 3a. High School Curriculum Model

SECONDARY VOCATIONAL EDUCATION SPECIFIC APPLICATION OF TECHNOLOGY

RATIONALE

Students in the last two years of their secondary school program are offered a variety of electives. Technology Education and Vocational Education are two of the many offerings which are listed as student choices along with advanced placement courses in mathematics and the sciences, advanced offerings in foreign languages, business, home economics, and many others.

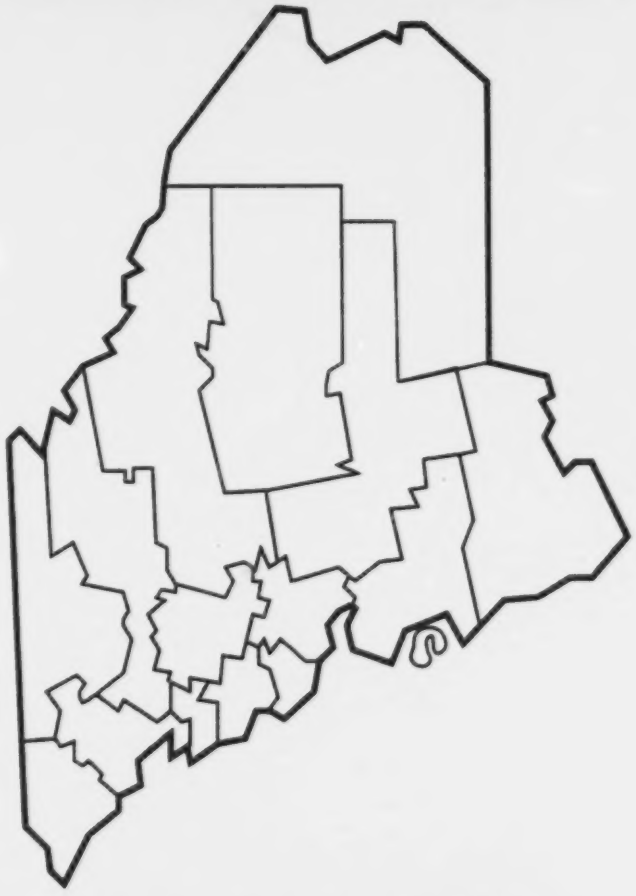
Technology Education has as its major goal the development of technological literacy for all students, regardless of their career choices and experiences. For a student who has not taken any high school technology education courses up to this point, this is an ideal time to start. A student who has elected previous technology education courses can use these two years to further his/her understanding of technological systems through problem solving activities that are more complex, and more closely associated with the world which they must soon face; or explore other areas of Technology Education.

The Vocational program has as its major focus the preparation of students for entry level employment in the business, industrial, or service sector. Its mission is to provide those individuals who desire and can profit from the program the job-related understandings, skills, and attitudes essential for success.

While both Technology Education and Secondary Vocational Education deal with knowledge about technology and its impact on human beings and the environment, the similarity ends when the goals of the programs are examined and compared. Technology Education provides a general literacy about technology, but does not provide the specific, job-related understandings, skills, and attitudes needed for employment in an identified occupation. Vocational Education, on the other hand, provides greater depth of understandings, skills and attitudes about technological issues in a much narrower subject area.

While there are definite differences in planned outcomes for students in secondary vocational programs and secondary technology education programs, it must be remembered that both areas provide a measure of technological literacy. In the interest of providing the best possible public education for the learner, cooperation between the two areas is essential.

TECHNOLOGY EDUCATION



IN MAINE

SECTION III - CONTENT OF TECHNOLOGY EDUCATION

THE CONTENT OF TECHNOLOGY EDUCATION

Technology education, like all other disciplines, has an identifiable knowledge base as well as processes for creating (see technological problem-solving model , Figure 2) the knowledge within the discipline. The following diagram represents one way of modeling the basic areas that make up that knowledge base. The model facilitates the identification of related topics for the development of courses, units, lessons, and Technology Learning Activities (TLA's).

The model uses three axes to illustrate a body of knowledge that centers on the examination of broad technological systems at their various levels of development in terms of the relationships of their system components. It incorporates several of the characteristics that distinguish technology education from the previous craft and industrial based approaches. They are the study of integrated technological systems, their various levels of historic development, and those systems as they relate to the cultural, biological, and environmental systems with which they interact.

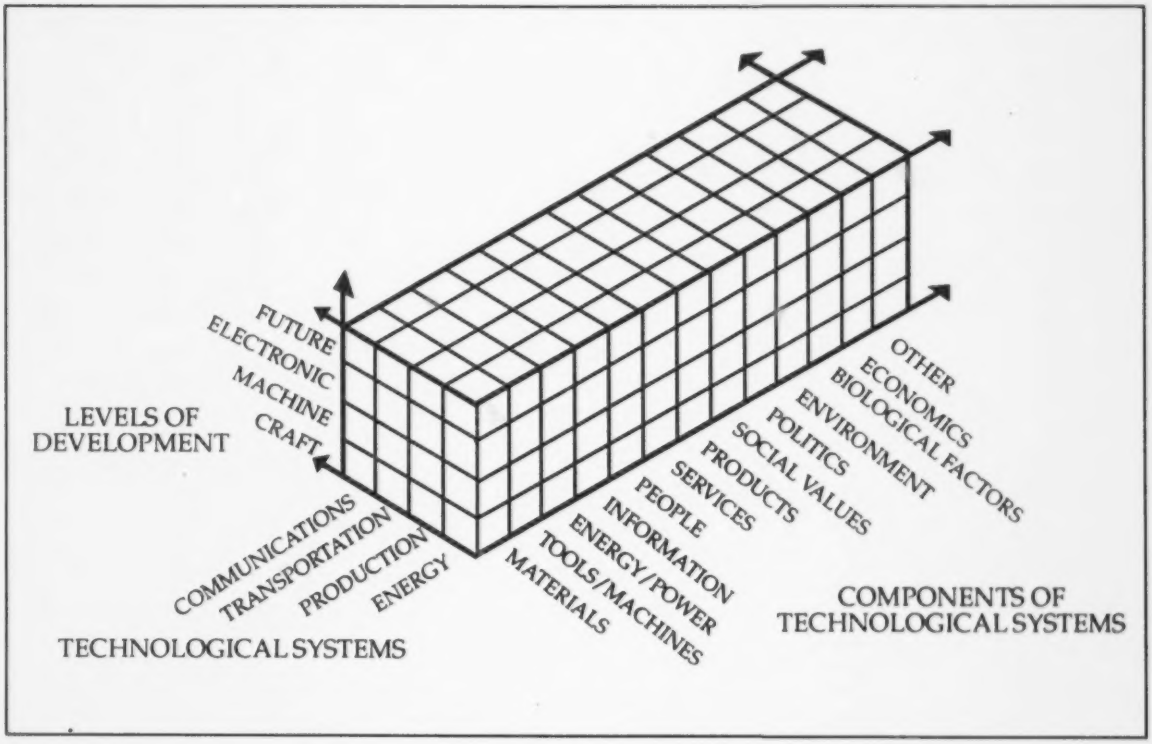


Figure 4: Content Model for Technology Education
Levels of development, systems, and components.
Based on a model by DeVore, P. (1980). Technology - an introduction.
Worcester, MA: Davis Publications

USING THE CONTENT MODEL

The model is useful to educators in that it provides a definition of the discipline's knowledge base and the individual cells created by the intersections of the factors suggest more specific topics for study in courses, units, and lessons. For example, the cell marked "A" in the model, Figure 4a, suggests the study of materials used in transportation systems during the machine age. The cell marked "B" suggests the study of the relationship of energy systems to the environment in the electronic age.

It is not intended that all the areas shown in the model must be included in specific courses or units, but that a curriculum leading to technological literacy should include all these areas and more.

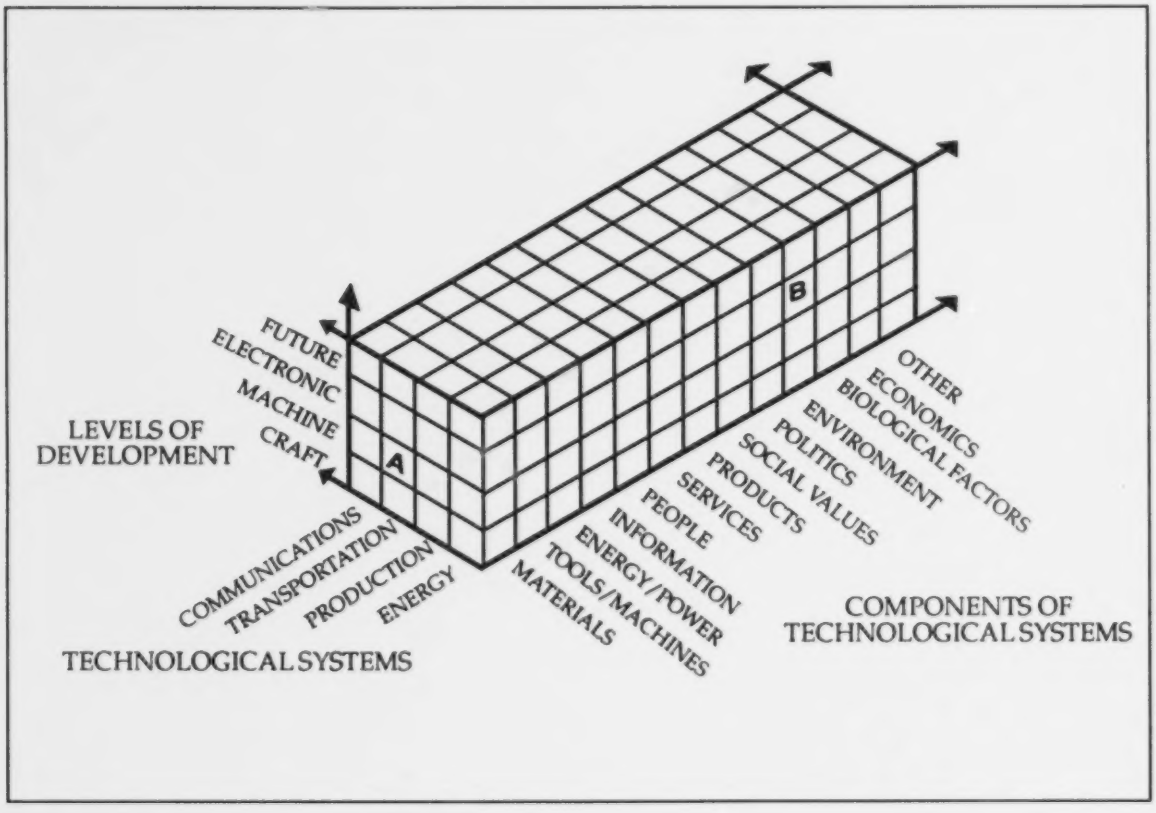


Figure 4a: Use of Content Model

INTRODUCTION TO THE SYSTEMS APPROACH TO TECHNOLOGY EDUCATION

This guide has presented "Design and Problem Solving" as the main PROCESS of technology and therefore, of Technology Education. The overall model of what has been described as the CONTENT of Technology Education, has been divided into four systems.

SYSTEM DEFINED . . .

> **"A system is one step above a machine. A system is a group of related elements that work together for a specific outcome. A system makes use of tools, mechanisms, machines, processes. and various resources to produce a desired result that will improve the quality of life" (p. 42).**
>
> **"...a system is a group of related elements that work together for a specific outcome. Technological systems are created by people to benefit people" (p. 55).**
>
> Goetsch, D. L. & Nelson, J. A. (1987). Technology and you. Albany, NY: Delmar Publishers, Inc.

The following pages present information on each of the four content area systems. Each contains:

- a definition of the system,
- a rationale for including the system in a study of technology education,
- specific examples from the system at the three levels of development,
- examples of items specific to that system that constitute the "components of technological systems," and
- an outline for studying the specific system.

It must be stressed that it is through the problem solving process that the content of technology education is to be presented. While much of the traditional content remains, the focus needs to be on the process of technology; for it is the problem solving process that can be adapted to the future, can be applied by students throughout their lives, and through which the content can be engagingly delivered.

While the above statement is easy to read, it is much more difficult to implement. A useful instrument to facilitate implementation is found in the fourth section of this curriculum guide: the Technology Learning Activity (TLA).

COMMUNICATIONS SYSTEM

DEFINITION:

Communications system: interrelated components which help people generate, send, receive, and understand a message.

RATIONALE:

Humans have always had a need to communicate in order to acquire things, get assistance, learn, and satisfy their needs and wants. The complexity of communication varies from society to society, some are more advanced, others primitive, but they all have established some form of communication. Few technologies have had as great an impact on the human condition as the invention and discoveries in the field of communications. A communications system must have inputs, processes, and outputs; more simply put, you need a transmitter, a channel over which the message travels, and a receiver. Communications may be used to inform, persuade, educate, and entertain.

Communications is a major industry in our world today. More than half of the American population is involved with the generation, manipulation, storage, transmission, or marketing of information. Study of the Communications System should include the domestic and global impacts of communication; such as historical, economic, political, cultural, and environmental issues.

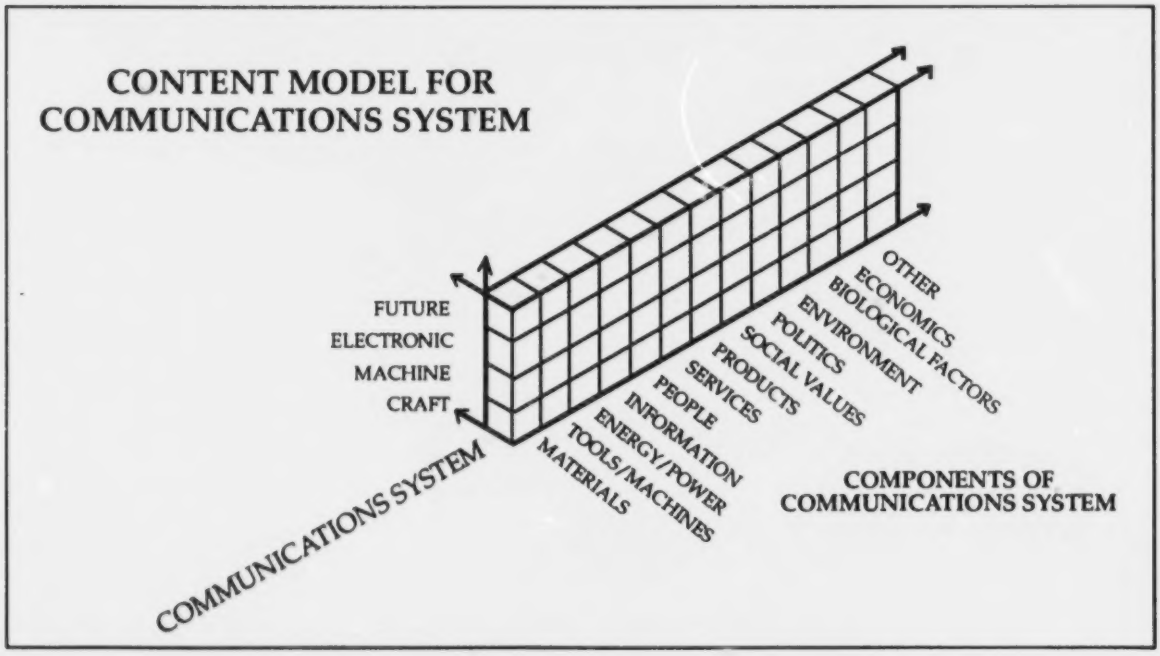
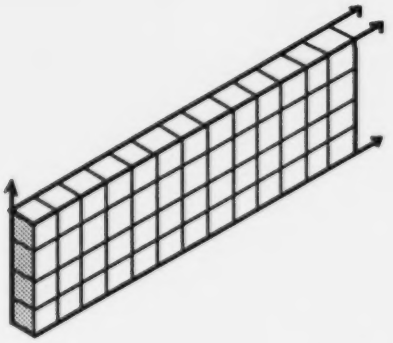


Figure 5: Content Model for Communications System

COMMUNICATIONS SYSTEM

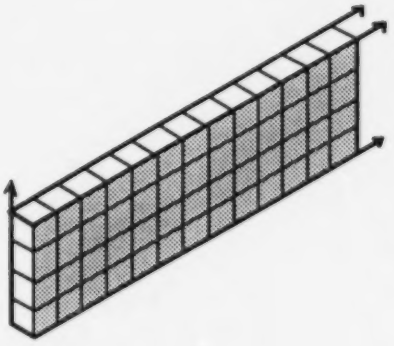
SAMPLE LEVELS OF DEVELOPMENT



CRAFT AGE: Symbols, Cave Drawings, Gestures, Hieroglyphics, Basic Languages and Drawings

MACHINE AGE: Letterpress, Offset Press, Telegraph, Photography, Technical Graphics

ELECTRONIC AGE: Radio, Motion Pictures, Telephone, Television, Computers, Satellites, CAD, Desktop Publishing, Facsimile



SAMPLE COMPONENTS OF THE COMMUNICATIONS SYSTEM

MATERIALS	Paper, Textiles, Inks, Solvents, Magnetic Tape
TOOLS/MACHINES	Presses, Drafting Machines, Computers, VCR, Pencil
ENERGY/POWER	Electrical, Laser
INFORMATION	Newspapers, Books, Radio, Television, Compact Disks
PEOPLE	Engineers, Draftsmen, Press Operators, Graphic Artists, Photographers, Writers, Reporters
SERVICES	Repair, Maintenance
PRODUCTS	Photographs, Graphs, Charts, Maps, Records, Tapes, Movies, Calendars, T-Shirts, Fax
SOCIAL VALUES	Entertainment, Persuasion, Information
POLITICS	Advertising, Campaign Materials, Commercials
ENVIRONMENT	Recycling, Conservation
BIOLOGICAL FACTORS	Health, Safety
ECONOMIC	Profit/Loss, Capital, Wages/Salaries

This listing is not all inclusive, but is intended to suggest ideas of specific components in the communications system model.

COMMUNICATIONS SYSTEM OUTLINE

NOTES:

I. INTRODUCTION:
- A. Definition of Communications System
- B. History of Communications System
- C. Function - Information transfer:
  1. Human to Human
  2. Machine to Machine
  3. Machine to Human, Animal

II. CLASSIFICATIONS OF COMMUNICATION:
- A. Visual/graphic communications
  1. Writing
  2. Freehand drawing and sketching
  3. Technical drawing
     a. Orthographic drawings
     b. Pictorial drawings
     c. Architectural drawing
  4. Photography
  5. Printing
     a. Image generation/design
     b. Preproduction -
        1. Image assembly,
        2. Image conversion,
        3. Image carrier preparation.
     c. Production (image transfer) -Relief, Screen, Offset, Gravure, Flexography, Other
     d. Finishing, binding and packaging
- B. Electronic communications
  1. Telecommunications
     a. Telephone
     b. Television
     c. Radio
     d. Satellites
     e. Other
  2. Graphic and electronic communications
     a. Word Processing
     b. Interface
     c. Photo copying
     d. Coding
     e. CAD - Computer Aided Design
     f. Facsimile
     g. Desktop Publishing
- C. Light communications
  1. Fiber optics
  2. Lasers

COMMUNICATIONS SYSTEM OUTLINE (CONT.)

NOTES:

D. Acoustic communications
    1. Oral
    2. Sound wave
    3. Interference

III. INPUTS
A. Need
    1. Inform
    2. Persuade
    3. Entertain
    4. Educate
B. Resources
    1. People
    2. Information
    3. Materials
    4. Tools and machines
    5. Energy
    6. Capital resources
    7. Time
C. Limiting factors

IV. PROCESSES
A. Generation (Design)
B. Transmission (Inputs)
C. Channel (Process)
D. Receiver (Output/Feedback)

V. OUTCOMES
A. Products
    1. Publishing
    2. Film
    3. Art/advertising
    4. Packaging
    5. Commercial printing
    6. Commercial photography
    7. Other
B. Impacts of the Communications System
    1. Social
    2. Environmental
    3. Cultural
    4. Political
    5. Safety and health
    6. Other
C. Careers related to communications system

VI. CONNECTIONS (RELATIONSHIPS) TO OTHER SYSTEMS
A. Role of the production system within the communications system
B. Role of the transportation system within the communications system
C. Role of the energy system within the communications system

COMMUNICATIONS SYSTEM RESOURCES

A suggested list of available resources, by no means all inclusive.

Bame, E. A., and Cummings, P. (1988). Exploring technology. Worcester, MA: Davis Publications, Inc.

Broekhuizen, R. J. (1988). Graphic communications. Mission Hills, CA: Glencoe Publishing Co.

DuVall, J. B., Berger, E. G., and Maughan Jr., G. R. (1981). Getting the message - the technology of communication. Worcester, MA: Davis Publications, Inc.

Goetsch, D. L., and Nelson, J. A. (1987). Technology and you. Albany, New York: Delmar Publishers, Inc.

Hacker, Michael and Barden, Robert. (1988). Living with technology. Albany, New York: Delmar Publishers, Inc.

Seymour, R. D., Ritz, J. M., and Cloghessy, F. A. (1987). Exploring communications. South Holland, Ill: Goodheart-Wilcox Co., Inc.

Wright, T. and Sterry, L. (ND). Industry and technology education - a guide for curriculum designers, implementors, and teachers. Lansing Ill: Technical Foundation of America

Todd, R., McCrory, D., Todd, K. (1985). Understanding and using technololgy. Worcester, MA: Davis Publications, Inc.

ENERGY SYSTEM

DEFINITION:

Energy system: interrelated components that locate, retrieve, and convert primary energy resources into usable forms.

RATIONALE:

Energy is a necessary resource for all technological activity and the acquisition of energy resources is an ever more important activity with global political, economical, and environmental impacts. It is critically important that all citizens are knowledgeable about energy systems, and have the skills to critically evaluate the alternatives available.

It is felt that even though energy is sometimes studied as an integral part of other technological systems, it is important enough to be studied as a system in its own right, and that if it is not, important aspects such as the location and refining of the resources may not be adequately covered.

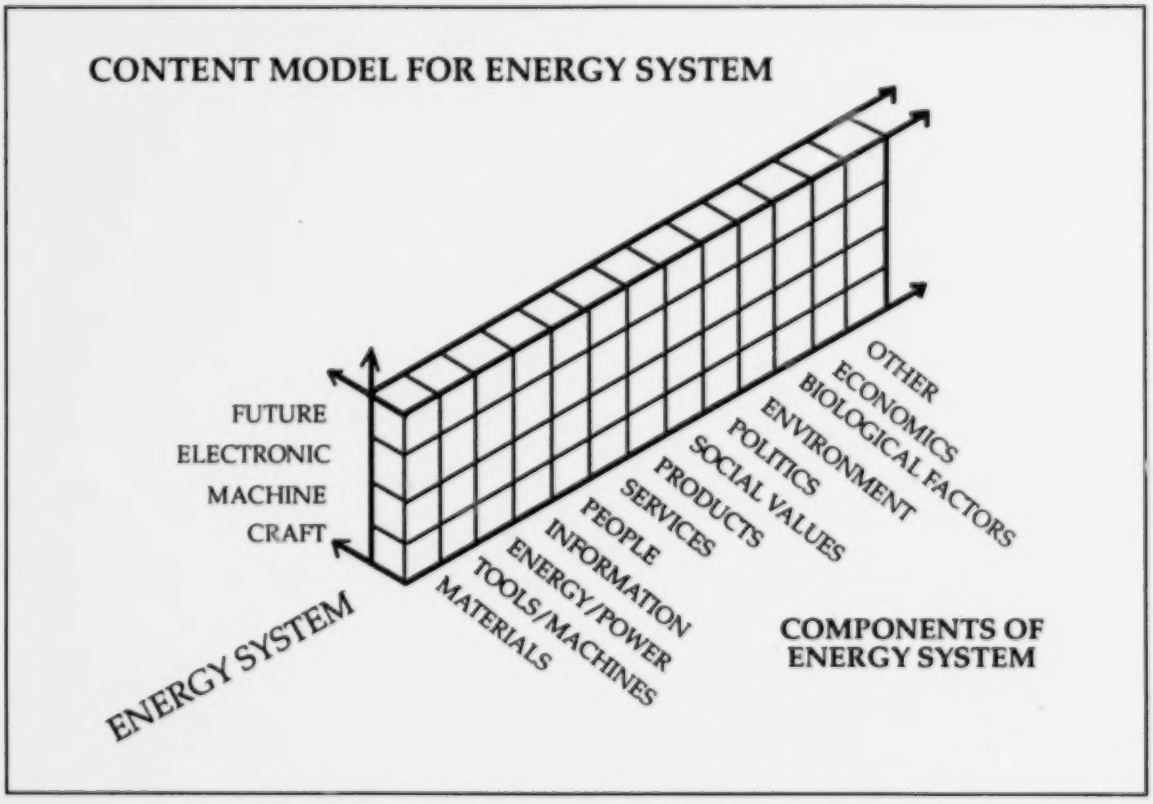
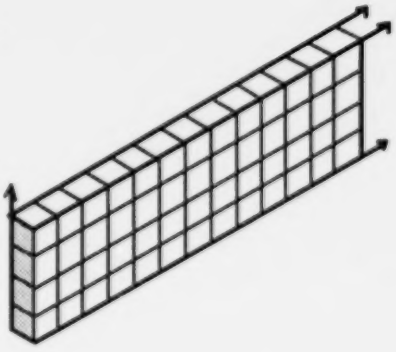


Figure 6: Content Model for Energy System

ENERGY SYSTEM

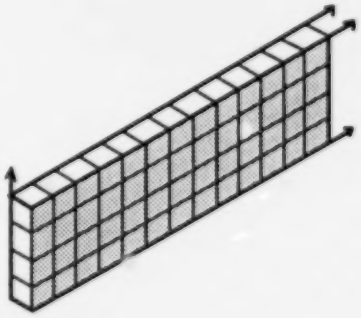
SAMPLE LEVELS OF DEVELOPMENT



CRAFT AGE: Horse-powered carriages, Wood and dung heating and cooking, Whale oil lighting, Ships powered by humans (rowing), Windmills, Water, Coal

MACHINE AGE: Internal combustion engines, Hydroelectric power, External combustion (steam) engines, Fossil fuels

ELECTRONIC AGE: Nuclear fission, Photovoltaic, Wind generated electricity, Rechargeable batteries, Nuclear fusion, Conversion of trash to energy, Synthetic fuels, Ocean thermal energy (OTE)



SAMPLE COMPONENTS OF ENERGY SYSTEM

MATERIALS	Coal, oil, wood, uranium, water, gas, etc.
TOOLS/MACHINES	Engines, wind mills, drilling rigs, mining tools, furnaces, etc.
ENERGY/POWER	People, animals, electricity, steam, nuclear, wind, etc.
INFORMATION	Geology, planning, economic, materials, etc.
PEOPLE	Engineers, technician , miners, drillers, businessmen, customers, etc.
SERVICES	Fuel delivery, refining, power transmission, repair, etc.
PRODUCTS	Fuel, energy
SOCIAL VALUES	Environment, health, economics, etc.
POLITICS	Energy policy, global economics, environmental policy, etc.
ENVIRONMENT	Pollution, asthetics, resource distribution, etc.
BIOLOGICAL FACTORS	Health, safety, habitat destruction, etc.
ECONOMIC	Costs vs. benefits, international payments, etc.

This listing is not all inclusive, but is intended to suggest ideas of specific components in the energy system model.

ENERGY SYSTEM OUTLINE

I. **INTRODUCTION**
- A. Definition of energy system
- B. History/Development
- C. Function - Extraction & Conversion

II. **CLASSIFICATIONS**
- A. Types
  1. Exhaustable
  2. Renewable
  3. Inexhaustable
- B. Forms of Energy
  1. Heat
  2. Light
  3. Mechanical
  4. Chemical
  5. Nuclear
  6. Electrical

NOTES:

III. **INPUTS**
- A. Need for a specific form of energy
- B. Resources used in the retrieval and conversion system
- C. Factors limiting the retrieval and conversion process

IV. **PROCESSES**
- A. Identification of form of energy or power needed
- B. Location of energy source
- C. Extraction of raw form of energy
- D. Conversion to a useable form
- E. Transportation/Storage

V. **OUTCOMES**
- A. Useable form of energy and/or energy service
- B. Impact of the energy extraction and conversion process on the environment and culture
- C. Careers in the systems of energy extraction & conversion

VI. **CONNECTIONS (RELATIONSHIPS) TO OTHER SYSTEMS**
- A. Role of the communications system within the energy system
- B. Role of the production system within the energy system
- C. Role of the transportation system within the energy system

ENERGY SYSTEM RESOURCES

A suggested list of available resources, by no means all inclusive.

Bame, E. A., and Cummings, P. (1988). Exploring technology. Worcester, MA: Davis Publications, Inc.

Bohn, MacDonald, Fales, Kuetemeyer (1986). Energy, power and transportation. Peoria, Ill.: Bennett and McKnight Publishing Co.

Goetsch, D. L., and Nelson, J. A. (1987). Technology and you. Albany, New York: Delmar Publishers, Inc.

Hacker, Michael and Barden, Robert. (1988). Living with technology. Albany, New York: Delmar Publishers, Inc.

Park, J. (1981). The wind power book. Palo Alto, CA: Cheshire Books.

Schwaler, A. E. (1980). Energy technology, source of power. Worcester, MA: Davis Publishing Co.

Schwaler, A. E. (1989). Transportation energy and power technology. Albany, New York: Delmar Publishers, Inc.

Taylor, J. R. and French, P. M. W. (ND). How lasers are made. New York, New York: Facts on File Publications.

Todd, R., McCrory, D., Todd, K. (1985). Understanding and using technololgy. Worcester, MA: Davis Publications, Inc.

PRODUCTION SYSTEM

DEFINITION:

Production system: interrelated components which are concerned with the conversion of materials into useful products.

RATIONALE:

For as long as humans have inhabited the earth, they have been concerned with altering the environment within which they live. Today our "environment" is characterized by things that we have produced to make our lives richer and more comfortable. The study of production systems examines not only the creation of these artifacts (things) but also how the artifacts and their creation have affected everything else (society, environment, etc.) throughout history.

As stated in the definition, the production system is concerned with converting materials into useful products. Based on where this conversion takes place we can label it as "construction" if it takes place on the site of use, or "manufacturing" if the conversion takes place somewhere other than where the product is to be used.

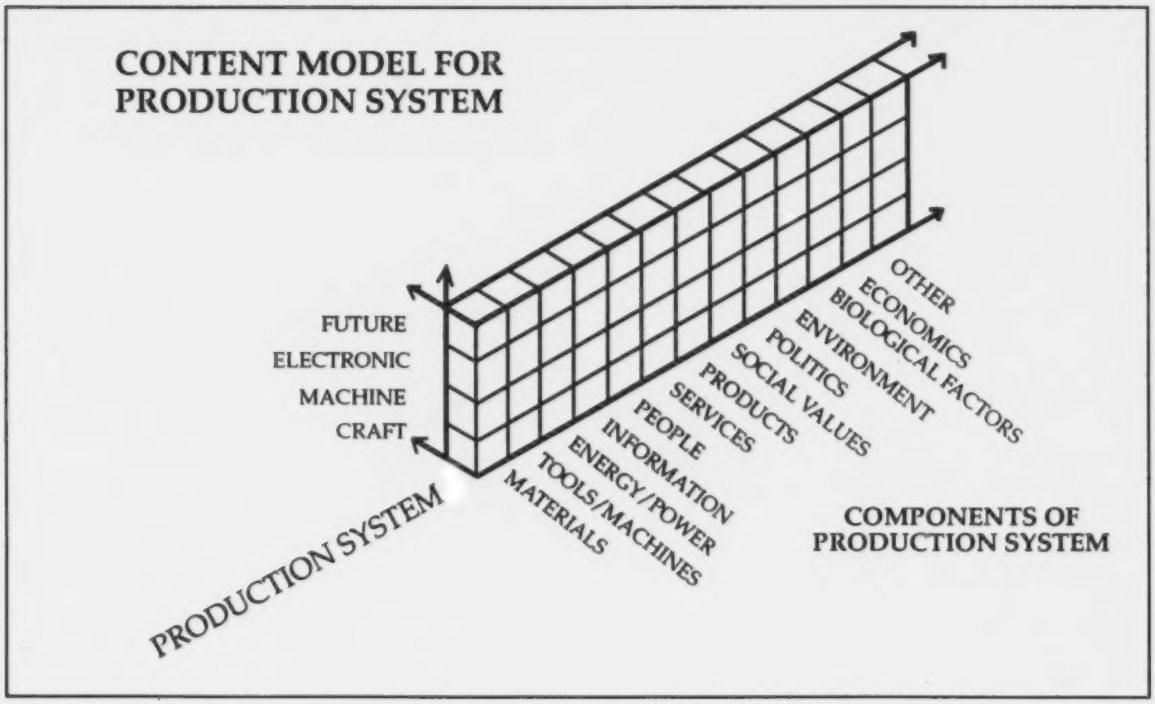


Figure 7: Content Model for Production System

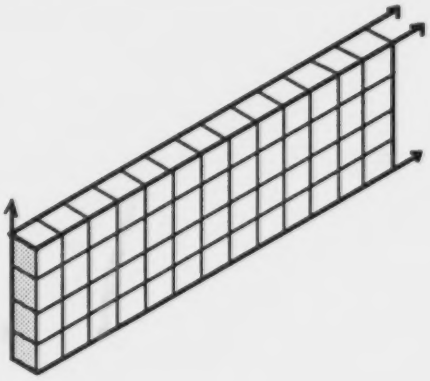
PRODUCTION SYSTEM

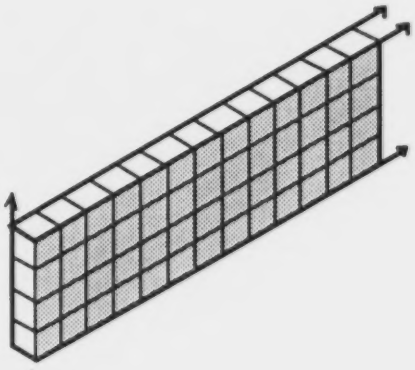
SAMPLE LEVELS OF DEVELOPMENT

CRAFT AGE: Hand tools, evolution of tools, custom production

MACHINE AGE: Mass-production, influences of machines and new power sources on production, industrial organization

ELECTRONIC AGE: Robotics, automation, synthetic materials





SAMPLE COMPONENTS OF PRODUCTION SYSTEM

MATERIALS	Wood, Metal, Plastic, Textile, Synthetic, Composite, Ceramic, etc.
TOOLS/MACHINES	Hand tools (use and care of, evolution, etc.), Machines (use and care of, evolution, etc.) Lasers, Robots, Specialized tools, etc.
ENERGY/POWER	Muscle, Water, Steam, Electric, Pneumatic, etc.
INFORMATION	Safety, Research and development, Engineering, Product testing, Marketing, etc.
PEOPLE	Company structure, Job description, Recruitment, etc.
SERVICES	Distribution, Repair, Maintenance, etc.
PRODUCTS	Shelter, Buildings, Dams, Roads, Tunnels, Artifacts, etc.
SOCIAL VALUES	Profit versus ethics, Fair marketing practices, etc.
POLITICS	Regulations/laws, Political influence, Protectionism, etc.
ENVIRONMENT	Recycling, Use of raw materials, Affect of materials on environment, etc.
BIOLOGICAL FACTORS	Genetic pesticides, Prosthesis (artificial limbs, etc.)
ECONOMIC	Profit/loss, Capital, Wages/salary, Factory location, etc.

This listing is not all inclusive, but is intended to suggest ideas of specific components in the production system model.

PRODUCTION SYSTEM OUTLINE

I. INTRODUCTION
- A. Definition of Production System
- B. History / development of Production System
- C. Function of Production System

II. CLASSIFICATIONS
- A. Manufacturing
  - 1. Custom Manufacturing
  - 2. Mass Production
- B. Construction
  - 1. Architectural
    - a. Residential
    - b. Commercial
  - 2. Civil
    - a. Roads
    - b. Bridges
    - c. Dams
    - d. Waterways
  - 3. Space

III. INPUTS
- A. Problem or need for specific product
- B. Resources used in production systems
  - 1. People
  - 2. Information
  - 3. Materials
  - 4. Tools/machines
  - 5. Energy
  - 6. Capital
  - 7. Time
- C. Factors limiting production systems
  - 1. Values
  - 2. Knowledge
  - 3. Finances
  - 4. Time
  - 5. People
  - 6. Perceptions
  - 7. Existing technology, etc.

IV. PROCESSES
- A. Forming
- B. Separating
- C. Combining

NOTES:

PRODUCTION SYSTEM OUTLINE (CONT.)

D. Conditioning

V. OUTCOMES

A. Products
   1. Packaging
   2. Marketing
   3. Distribution
   4. Reclamation
   5. Servicing

B. Impacts
   1. Environmental
   2. Economic
   3. Political
   4. Cultural
   5. Other

C. Careers related to production systems

NOTES:

VI. CONNECTIONS (RELATIONSHIPS) TO OTHER SYSTEM

A. Role of the Energy System within the Production System
B. Role of the the Transportation System within the Production System
C. Role of the Communications System within the Production System

PRODUCTION SYSTEM RESOURCES

A suggested list of available resources, by no means all inclusive.

DeVore, Paul W. (1980). Technology an introduction. Worcester, MA: Davis Publications, Inc.

Todd, R., McCrory, D., Todd, K. (1985). Understanding and using technololgy. Worcester, MA: Davis Publications, Inc.

Hacker, Michael and Barden, Robert. (1988). Living with technology. Albany, New York: Delmar Publishers, Inc.

State Education Department. (1986). Technology education - production systems. Albany, New York.

Wright, T. and Sterry, L. (ND). Industry and technology education - a guide for curriculum designers, implementors, and teachers. Lansing Ill: Technical Foundation of America.

TRANSPORTATION SYSTEM

DEFINITION:

Transportation systems consist of interrelated components which apply technological resources in order to move people, cargo, and things from one place to another.

RATIONALE

Transportation is a part of our everyday life. Everyone may be surprised to find how really dependent they are on transportation systems. Through history, people have moved themselves and their possessions across land and water, eventually through air and most recently in space. The reasons for this movement are many: survival, curiosity, exploration, trade and commerce. Today we are moving goods and people at some astonishing rates with more accuracy and reliability than every imagined. We live in an interdependent world in which mobility is of the utmost importance, yet we often take for granted the ease with which we can move intercontinentally and perhaps, someday, interplanitarily.

In the study of the transportation system students should be exposed to the various modes of transportation and given the opportunity to examine and experiment with their complex nature and its effect on our social, environmental, economic and political systems. A study should also include the historical context of transportation in the present, past and future and its impact on our society.

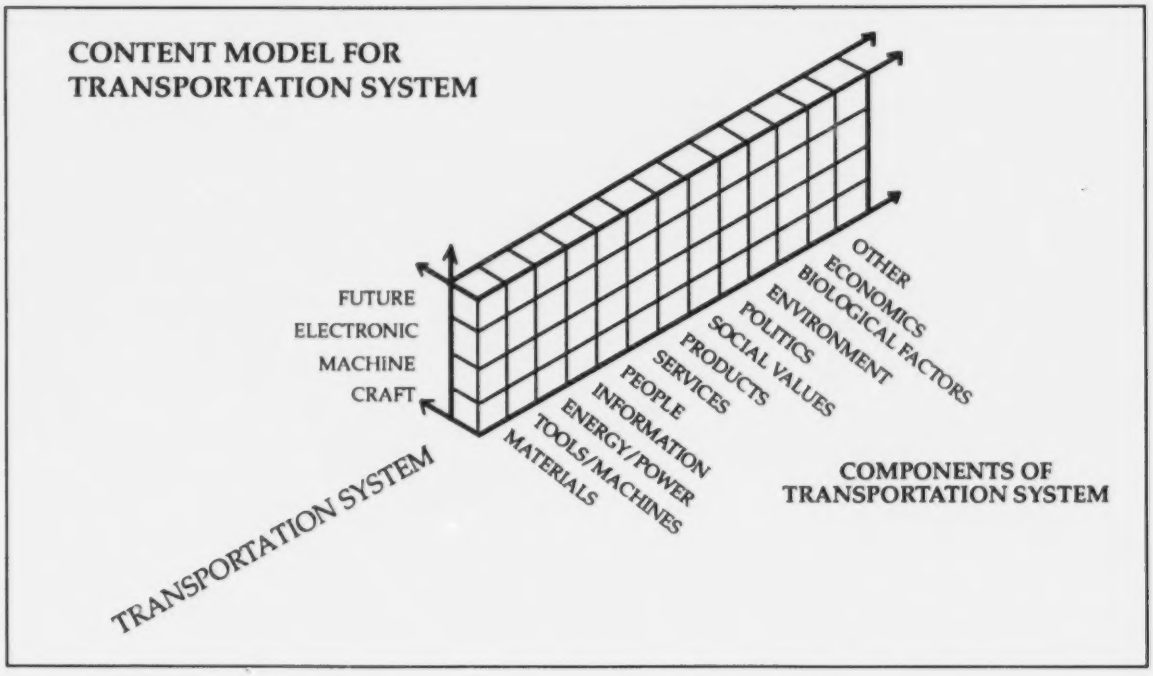
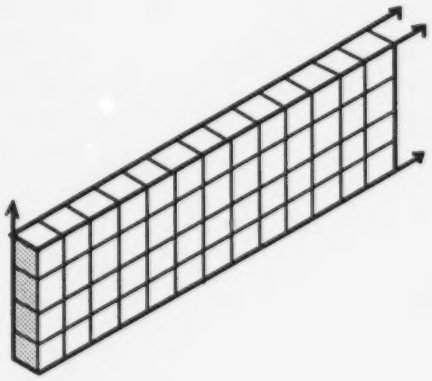


Figure 8: Content Model for Transportation System

TRANSPORTATION SYSTEM

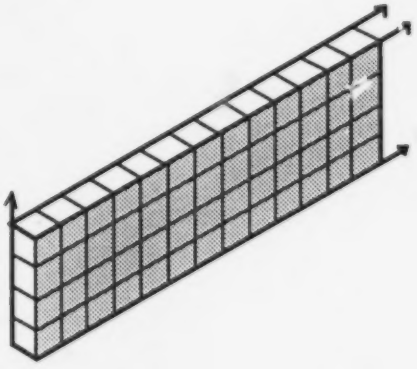
SAMPLE LEVELS OF DEVELOPMENT

CRAFT AGE: Foot, draft animals, raft, wagon, sail, hot air balloon, pipeline



MACHINE AGE: Automobile, train, power vessels, elevators, conveyors, aircraft, motorcycles

ELECTRONIC AGE:
Magnetic levitation, high speed rail, space travel



SAMPLE COMPONENTS OF TRANSPORTATION SYSTEM

MATERIALS	Fuels, Metals, Plastics, Ceramics, Textiles, Composites
TOOLS/MACHINES	Production equipment, Speciality equipment
ENERGY/POWER	Fuels, Gas, Propane, Methane, Engines, 4 Stroke
INFORMATION	Management, Organizational, Schedules, Advertising
PEOPLE	White/blue collar, Service, Parts, Sales, Designers, Engineers
SERVICE	Maintenance, Parts supply, Fuel supply, etc.
PRODUCTS	Cars, Trucks, Buses, Trains, Planes, Rockets, Helicopters, etc.
SOCIAL VALUES	Fuel prices, Laws
POLITICAL INTERACTION	Laws, Regulations, Taxes, Trade, Global
ENVIRONMENTAL	Pollution, Development, Recycling
BIOLOGICAL FACTORS	Ergonomics
ECONOMIC	Costs, Wages, Price wars, Embargoes, Trade wars

This listing is not all inclusive, but is intended to suggest ideas of specific components in the transportation system model.

TRANSPORTATION SYSTEM OUTLINE

NOTES:

I. INTRODUCTION

A. Definition of the transportation system
B. History/Development of the transportation system
C. Function /Purpose - need for the transportation system

II. CLASSIFICATIONS

A. Modes
   1. Land transportation systems
      a. Road systems Automobile - Automobile, Trucking
      b. Rail systems - Trains, Monorail, Subway
      c. Pipe Line systems
      d. Other - Elevator, Conveyor, Cable
   2. Marine Transportation Systems
      a. Passenger
      b. Cargo
      c. Military
      d. Research
      e. Specialty
   3. Air Transportation Systems
      a. Lighter than air
      b. Heavier than air
      c. Airport terminals & Facilities
   4. Space Transportation Systems
      a. Rocket
      b. Shuttles
      c. Labs
      d. Stations
      e. Satellites

B. Vehicles
   1. Passenger
   2. Cargo

C. Types
   1. Fixed
   2. Flexible
   3. Intermodal

III. INPUTS

A. Problems or need to move people or cargo
B. Resources used in the transportation system
   1. People
   2. Information
   3. Materials
   4. Tools/Machines
   5. Energy
   6. Capital, Time, Etc.

TRANSPORTATION SYSTEM OUTLINE (CONT.)

C. Limiting factors
   1. Finances/economics
   2. Knowledge
   3. Time
   4. People
   5. Environment

NOTES:

IV. PROCESSES

A. Management
   1. Planning
   2. Organizing
   3. Controlling

B. Production
   1. Preparing
   2. Moving
   3. Completion

V. OUTCOMES

A. Movement of People, Cargo and Things
B. Products, services
C. Impacts - environmental, political, cultural, etc.
D. Careers

VI. CONNECTIONS (RELATIONSHIPS) TO OTHER SYSTEMS

A. Role of the communications system within the transportation system
B. Role of the energy system within the transportation system
C. Role of the production system within the transportation system

TRANSPORTATION SYSTEM RESOURCES

A suggested list of available resources, by no means all inclusive.

Bame, E. A., and Cummings, P. (1988). Exploring technology. Worcester, MA: Davis Publications, Inc.

Bohn, MacDonald, Fales, Kuetemeyer (1986). Energy, power and transportation. Peoria, Ill.: Bennett and McKnight Publishing Co.

Deold, Sheets, Alexander. (1986). Transportation - the technology of moving people & products. Worcester, MA: Davis Publications, Inc.

Fales, J. F. and Kuetemeyer, V. F. (1988). Technology today and tomorrow. Mission Hills, CA: Glencoe Publishing Co.

Hacker, Michael and Barden, Robert. (1988). Living with technology. Albany, New York: Delmar Publishers, Inc.

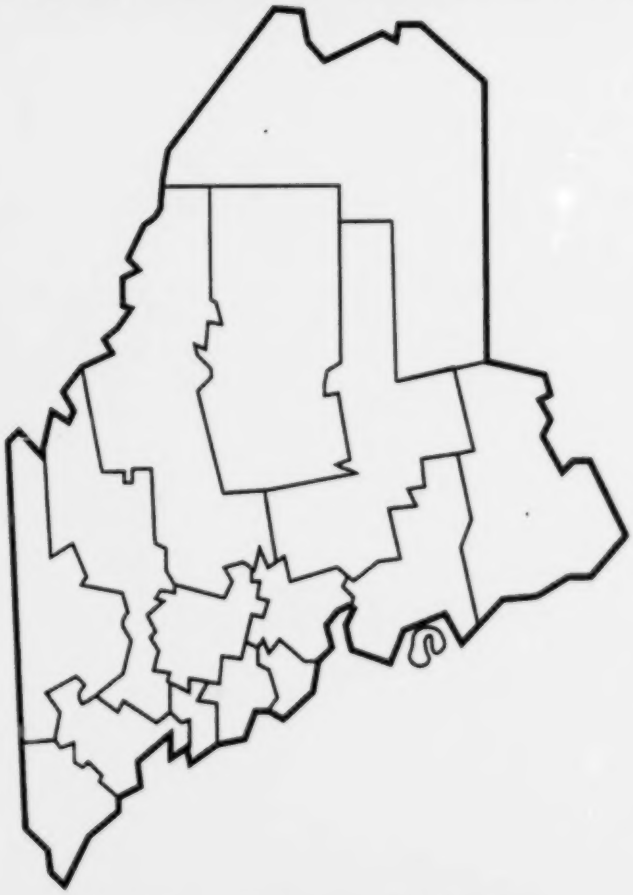
Heiner, C. W. and Hendrex, W. R. (1980). People create technology. Worcester, MA: Davis Publications, Inc.

Kline, R. (1985). The ultimate paper airplane. New York, New York: Simon and Schuster, Inc.

Schwaler, A. E. (1989). Transportation energy and power technology. Albany, New York: Delmar Publishers, Inc.

Todd, R., McCrory, D., Todd, K. (1985). Understanding and using technololgy. Worcester, MA: Davis Publications, Inc.

TECHNOLOGY EDUCATION



IN MAINE

SECTION IV - TECHNOLOGY LEARNING ACTIVITIES (TLA'S)

TECHNOLOGY LEARNING ACTIVITIES

INTRODUCTION

- What are Technological Learning Activities
- Distinguishing Characteristics of TLA's

SAMPLE TLA'S

- Ornithological Feeder - 1 4-4
- Paper Car Engineering/Design - 2 4-6
- Commercial Design Project - 3 4-8
- Wearable Message - 4 4-12
- Why Bridges "Usually" Stand Up - 5 4-14
- Fluid Power Station - 6 4-16
- Educational Toy Design - 7 4-18
- Space Structures - 8 4-20
- Waste Management Media Search - 9 4-22
- Long Distance Vehicle - 10 4-24
- America's Cup Challenge - 11 4-26

INTRODUCTION

The laboratory activities used to achieve the objectives of Technology Education are commonly described as Technology Learning Activities, or **TLA's**. TLA's are the primary methodology of Technology Education and are used to develop critical thinking, creative thinking, and problem solving skills needed to reinforce the technological system concepts studied. They are similar in many ways to the laboratory activities of industrial arts, but are different in that they focus more on research and the creative solutions to problems for which there are many variations of answers, and less on tool skill development and object making.

Distinguishing Characteristics of TECHNOLOGY LEARNING ACTIVITIES (TLA'S)

1. Activities are either design or investigative problems, or skill development problems to prepare the students for higher level (problem solving) activities.

2. Activities focus as much as possible on the higher level activities.

3. Problem solving (design) methodology includes, in a variety of forms: problem definition, problem analysis, creative solution generation, development, and evaluation.

4. Problems should allow for a variety of creative solutions and problem solving methods.

5. Activities are a means to understanding technological systems, relationships to other disciplines and the development of problem solving skills.

6. Activities are relevant, interesting, and challenging to the learners.

TLA FORMAT

Even though there is much room for variation in the format of TLA's there are several features common to most which represent good teaching strategies. Following are samples of TLA's currently being used in Maine classrooms. The bold headings are common to many TLA's being developed around the country and are recommended for use in Maine.

It must be stressed that these TLA's are simply examples of what can be accomplished in the realm of Technology Education. A variety of quality TLA's, presently being implemented in Maine and throughout the nation, will be presented to the profession during future, state-wide, in-service workshops. These will be delivered via a joint effort by the Department of Technology at the University of Southern Maine, Bureau of Vocational Education, and the T.E.A.M. Executive Board.

Furthermore, it should be emphasized that <u>all</u> instructors will be encouraged to develop their own TLA's to meet local interests and needs.

1 THE ORNITHOLOGICAL FEEDER

PROBLEM STATEMENT:

Design and construct an ornithological feeder taking into consideration the following items as they are affected by the design, construction and use of the feeder:

environment
social values
materials
tools and machines
careers

OBJECTIVES:

Given a list of 20 birds, each student will be able to pick out 5 which live in northern Maine.

Given a list of foods, students will be able to pick out those which are common to birds.

Given a list of career options, each student will be able to identify those which would include a knowledge of birds and their habitat.

Each student will be able to list 4 positive and 3 negative relationships between man and birds.

Each student will be able to identify those tools and machines used in the design and construction of this feeder.

Each student will be able to identify those materials used in the construction of the feeder and indicate some knowledge as to the manufacture of these materials.

MATERIALS & RESOURCES:

A one gallon jug, a one gallon jar, (1) 2 liter bottle, (3) 16 oz. bottles, (1) 12" piece of PVC, (1) sheet of plastic 3/16 x 12 x 12, (3) pieces of pine board 1" x 6" x 18", one piece of conduit 1" x 24", wooden dowel 3/8" x 30".

Fasteners: (available as needed)

Glue, nails, screws, pop rivets, nuts & bolts, velcro

LIMITATIONS:

- Must be easy to load
- Must be easy to clean
- Feeder must be designed to hang
- Must use at least three different materials in construction
- Must be waterproof (feed must not get wet)
- Feeder must hold at least one quart of birdseed

THE ORNITHOLOGICAL FEEDER - 2

PROCEDURES:

- Form a company
- Select a company name
- Design a company logo
- Design feeder
  - 3 thumbnail sketches
  - 1 set of working drawings
  - 1 list of materials
- Construct feeder
- Research birds
  - Kinds of birds
  - Habitat
  - Feed
    - Kinds of feed
    - Where grown
    - How does it get to you
  - Social value
    - Value to man
  - Develop and/or design an advertisement for your feeder. This will be put on TV.

EVALUATION:

Each company member will evaluate every other company member as to what each has contributed to the success or failure of the project.

Each company will make a presentation to the class. Every member of the company must have some part in the presentation. The presentation should cover the following parts:

- Sketches and drawings
- Demonstration of feeder
- Completion of behavioral objectives
- Present library research
- Present your TV advertisement

This project will be evaluated by the members of the class.

- 20% = Feeder completion
- 20% = Meet behavioral objectives
- 20% = Project meets stated limitations
- 20% = Demonstrate completion of library research
- 20% = Complete TV advertisement

FEEDBACK:

Submitted By: Robert Moulton
Caribou Middle School

2 PAPER CAR ENGINEERING/DESIGN

STATEMENT OF PROBLEM: Your three or four person engineering team is being charged with designing, constructing, marketing, and racing a paper car.

NOTE: Most of what you will need is presented in this Technology Learning Activity, however there are a few items that need to be clarified:

- *race*: A ramp will be provided, the cars are to be released from the top of the ramp, the car that rolls the furthest will receive the most points. All others will receive points as a percentage of the longest run.
- *car show*: Groups are to consruct a display for their cars; during the car show instructors and students from classes will "shop" for a car by scoring the cars, displays, commercials, and drawings.
- *ad layout*: These are what you would see if your car was advertised in a newspaper or magazine.
- *TV commercial*: Your group is to produce a 30 second television commercial for your car. This commercial must be taped, be in good taste and reasonably realistic.

OBJECTIVES:

The student will:

1. Develop leadership, cooperation, and responsibility skills while working within a cooperative learning group.
2. Apply their knowledge of mechanical drawing concepts and practices in order to graphically present their car designs.
3. Develop an understanding of and work with a pattern layout.
4. Develop, test and evaluate their design ideas.
5. Investigate the areas of media and marketing while developing a display, as well as, graphic and electronic media advertisements for their paper cars.

MATERIALS:

drafting paper
glue
wooden dowels (for axles only!)

NOTE: the above list pertains to the car only, there are no material restrictions placed on the display, commercial, etc.

LIMITATIONS:

The groups have six school days to complete this Technology Learning Activity. Day seven has been set aside for the car show and great paper car race.

The paper car must:

- be under 75 cm wide and under 200 cm long.
- carry 2 removeable erasers (1 cm x 2.5 cm x 6.5 cm).
- weigh under 80 grams with payload.
- have more than two working wheels.
- have at least two working axles.
- have the class and group number on the license plate.

The display must be identified by:

- the name, type and location of school.
- the month and year completed.
- the class and group number.

PAPER CAR ENGINEERING/DESIGN - 2

PROCEDURE:

1. Select a president and company name.
2. Designate jobs to the team members:

MARKETING	logo design _____
	print media layout _____
	television commercial _____
	display design _____
ENGINEERING	vehicle design _____
	3-view drawing _____
	isometric drawing _____
	pattern layout _____
	wheel layout _____
MANUFACTURING	assembly of car _____
	construction of display _____

3. Group members are to begin working on their designated jobs. In addition to being a contributing group member, the President needs to monitor the progress of the group, conduct brain-storming sessions, hold conferences to discuss key problems, etc.
4. Prepare for race, car show, and grading.
5. Set up display by end of day six.

EVALUATION:

GROUP GRADE:	20%	appearance/quality of vehicle
	20%	placement in race
	20%	quality and completeness of drawings
	20 %	advertising
	20%	display at car show

INDIVIDUAL GRADE - based on how well the group does and what portion of the total group work was done by the individual.

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

NOTE: Much of the material for the above TLA was developed and presented by Kjell-Jon Rye, Bellevue, WA

Submitted By: John Kraljic
Garland Street Middle School - Bangor

3 COMMERCIAL DESIGN PROJECT

PROBLEM STATEMENT: Design an Office/Commercial building to fit the piece of property marked "TOWN" on the attached Cape Elizabeth Property Map (Sheet U-21).

OBJECTIVES: The student will:

1. Apply their knowledge of architectural drawing concepts to a commercial design project.
2. Apply research and design techniques to determine specific space requirements of a commercial type building.
3. Complete several kinds of architectural drawings of their proposed design. (Floor plan, site plan & Elevations)

MATERIALS & RESOURCES: Drafting Equipment, Drafting Paper, Town Property Map, Local Zoning Ordinances

LIMITATIONS:

- The proposed commercial building should fit within the styles of the surrounding properties and must be an allowable type of structure according to the local zoning ordinances.
- The designer will select a use for the proposed building and will research what will be necessary to make the building functional. (Example - If a student chooses to design a video-tape rental store, the student must research and find out what kind space requirements, rooms, equipment, etc. are necessary to make the proposed building fit its purpose.)
- Cost of the building should not exceed $200,000.00. (Calculate cost at $80.00 per square foot for commercial property).
- Building codes require setbacks of: Front..... 100' - 0"
  Sides.....25' - 0"
  Rear.....50'- 0"
- Building will have 5 employees and not more than a dozen people on site at one time.
- Building must be handicap accessible.

PROCEDURES:

- Students determine a proposed use for their building.
- Research necessary space requirements for building.
- Draw preliminary sketches of floor plan layout.
- Determine size of proposed building and test to:
  a. Fit within the budget limitations
  b. Fit within the setbacks limits of property
  c. Contain all necessary rooms/space for design
  d. Fit surrounding area & piece of property
- Determine style of exterior of building.

COMMERCIAL DESIGN PROJECT - 2

- Draw floor plan with door & window schedule.
- Draw site plan with appropriate parking, handicap access, roads, delivery/ loading area, landscaping, etc.
- Draw front and side elevations.
- Prepare presentation as if to planning board for your proposed commercial design.

EVALUATION:

Each drawing is graded on accuracy, neatness, drawing techniques, and for standard architectural formatting. Student also receives a project grade for complete package of preliminary sketches, cost estimates, drawings, and outline of presentation to planning board.

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

Important that student selects a design that he/she has a real interest in. Try to pursuade students to design a commercial building relating to a possible career they are interested in or a family business. Students will be spending about 4-5 weeks on this project.

Sumitted By: Cliff MacWhinnie & Gary Lanoie
Cape Elizabeth High School

COMMERCIAL DESIGN PROJECT - 3

Excerpt from zoning ordinances from Cape Elizabeth, Maine

Sec. 19-2-4. Business District A - Permitted Uses: The following buildings or uses only are permitted in Business District A, after the planning board shall have approved the site plan accompanying the application, with the exception of (h) below: [Amended, eff. 1/13/82]

(a) any building or use permitted in any Residence District except detached single family dwellings, subject to any conditions set for such building or use;

(b) business or professional office;

(c) retail outlet, such as drugstore, bakery, or grocery, with no outside storage of goods or merchandise;

(d) service establishment, such as barbershop, beauty shop, tailor shop, or laundromat (without use of flammable solvents);

(e) restaurant, subject to the approval of the zoning board; [Amended eff. 1/13/82]

(f) parking lot, subject to the approval of the zoning board; [Amended eff. 1/13/82]

(g) gasoline service station or repair garage, subject to the approval of the zoning board; [Amended eff. 1/13/82]

(h) two exterior commercial signs, to advertise goods produced or sold on the premises, or services rendered, or to show that the premises are for rent or for sale. A two-sided sign shall contain not more than 40 square feet. Both signs may be illuminated only by a steady, shielded light. In addition, a sign, illuminated by a steady, unshielded light, may be incorporated into an exterior sign or located behind a display window, provided that it does not exceed 10 square feet per side in area;

(i) millworking and woodworking shops and facilities, with no outside storage of equipment and materials;

(j) any building or use customarily accessory to those above.

Cape Elizabeth property map - Sheet U-21

WEARABLE MESSAGE

PROBLEM STATEMENT: A local screen printing company has contacted our school in reference to ideas for a logo/design to be placed on one of their T-shirt lines. The target group for these T-shirts will be high school age students. Your task is to design and print a prototype T-shirt to submit to this company for their consideration.

OBJECTIVES: The student will:

1. Use the design process to assemble a message for printing by the screen process method.
2. Incorporate principles of good design in their T-shirt logo/design.
3. Design and print a message using the screen printing process.
4. Identify the hazards related to working with inks and solvents and explain the system for disposal of hazardous waste from the screen printing process.

MATERIALS & RESOURCES: Clip Art Books, Transfer Type, Computer, Computer Click-Art, Paper, "Penstick" Technical Drawing Pens, Thermofax Machine, Thermal Silk Screens, Plastic Frames, T-shirt printing base, Silk screen inks, Squeegee

LIMITATIONS:

- The logo/design will be suitable for sale to high school students. The design must be in good taste. (Instructor has final decision on any designs)
- Logo/design must convey a message and conform to basic principles of good design.
- Image size must be no larger than 7" x 9".
- Design should contain both lettering & graphics.
- Design will be printed using the thermal screen process.
- Design placement may be either on the front or back of a T-shirt.
- Logo/designs must be printed on a white or light colored T-shirt.

PROCEDURES:

- Introduction & design principles
- Design process
- Draw at least five thumbnail sketches.
- Refine two of the thumbnails into rough sketches.
- Select final sketch of design and prepare a comprehensive layout. (Model or prototype of your design)
- Prepare your "Paste-up" or "Camera Ready Copy"
- Expose screen with camera ready copy in the thermofax machine.
- Mount screen to plastic frame.
- Set up and test print on paper.
- Make any corrections & adjustments in screen.

- Test again & when ready - print on your T-shirt.
- Set ink when dry by turning t-shirt inside out and ironing the back side of the printed design.

EVALUATION: Submit entire package of thumbnails, rough sketches, comprehensive layout, camera ready copy, three screen prints of design on paper, and the printed T-shirt. Evaluation based on meeting deadlines, completeness, neatness, creativity, using principles of good design and quality of final screen printed design.

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

Have deadlines when parts of the designs are due (Example-Thumbnails and rough sketches due on certain date, comprehensive and camera ready by another date, and then completed design package on final date) Students will probably need about two to three weeks to complete this design.

Submitted By: Gary Lanoie
Cape Elizabeth High School

5 WHY BRIDGES "USUALLY" STAND UP

STATEMENT OF PROBLEM: Two person R & D teams will research construct and test a bridge designed to hold as much weight as possible using materials provided.

OBJECTIVES: The student will:

1. Develop team work, cooperation, and problem solving skills while researching and developing their design problem.
2. Apply their knowledge of mechanical drawing concepts and skills in order to graphically present their design ideas.
3. Develop an understanding of the design process and why it is necessary.
4. Develop, test, and evaluate their design.
5. Make a presentation and display explaining their design.

MATERIALS & RESOURCES:

drafting paper	$50,000
glue - 1 ounce	$20,000
1/8 x 1/8 / 18" balsa wood strips	$50,000
string - 3 feet	$20,000

LIMITATIONS:

The groups have 3 weeks to research, develop, and construct their bridge designs with the last day for testing.

Bridge History must:
- have at least four different references
- be at least two typed pages in length

Types of Bridge Designs must:
- include at least 3 different designs
- explain how each design works

Design of Bridge must:
- include 3 to 5 thumbnail sketches
- include 2 rough sketches
- include 1 mechanical drawing

The Display must Identify:
- the names of presentors
- types of stresses and direction

The Bridge must:
- cost no more that $1,000,000
- span 16 inches
- bé at least 2 " wide and no more than 4" high
- not have any supports that touch the floor

BRIDGES - 2

PROCEDURE:

1. Introduction to bridge design problem
2. History of bridges

Research
- history of an existing bridge
- types of bridge design

Design
- bridge design
- thumbnails
- rough sketches
- mechanical drawing

Construction
- assembly of bridge
- construction of display

EVALUATION:

20% history of an existing bridge
20% types of design research
20% mechanical drawing
20% bridge construction
20% bridge presentation

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

- student questionnaire
- observations of what worked and didn't work

Submitted By: Randy Perkins
Cape Elizabeth Middle School

6 FLUID POWER STATION

STATEMENT OF THE PROBLEM: Design and construct a fluid power station which will produce a mechanical advantage and will perform work.

OBJECTIVES: The student will:

1. Develop teamwork and problem solving skills through active participation in cooperative learning groups.
2. Apply their knowledge of physics and mathematics towards engineering and designing a product.
3. Apply creative and critical thinking skills in the design of this product.
4. Gain an understanding of some of the many different materials available in the world today
5. Develop safe working habits while constructing this product.

MATERIALS & RESOURCES:

PVC Tubing: 1/2", 3/4", 1 1/2", 2", 3", 4"
Leather
Rubber
Flexible tubing
1/8" steel plate
Wood
Fasteners
24 gauge sheet steel
Silicon sealant
Glues 7 adhesives
Welding equipment

LIMITATIONS:

- Input force is not to exceed 10 lbs.
- Fluid pressure is not to exceed 5 psi.
- Output force is to be at least 50 lbs.
- Fluid volume must not exceed one pint
- Station must be mountable on a 12" X 12" wood base.
- Source of power can not be electrical.
- Must use materials provided (Listed above).
- Instructor permission necessary for any other materials.
- Must perform work (Lift a weight, compress/compact material, etc.).

FLUID POWER STATION - 2

PROCEDURE:

I. DESIGN
- A. IMPLEMENTATION OF FLUID POWER STATION
  1. What work will station do?
  2. How will it do the work
- B. CALCULATIONS AND DESIGN
  1. needed input force
  2. needed output force
  3. source of input force
  4. actuator
- C. DRAWINGS
  1. rough sketches
  2. final drawings
     a. dimensions
     b. drawn with drafting tools
- D. BILL OF MATERIALS
- E. PROCEDURE

II. CONSTRUCTION
- A. Construct according to procedure
- B. Instructor permission needed to use any power tool
- C. Mount station on a 12" X 12" wood base
- D. Finish applied to all applicable parts

III. TESTING
- A. Test
  1. lifting a certain weight
  2. Compressing/compacting material
- B. Trouble shoot

IV. EVALUATION
- A. Did the station work?
- B. What problems had to be overcome?
- C. How could it be improved?

EVALUATION:

1. Design, planning, calculations 25%
2. Implementation for work 25%
3. Construction-finished product 25%
4. Work habits 25%

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

- Test with water first before using hydraulic fluid
- Need to have an accurate means of measuring mechanical advantage
- Establish due dates stages of the project.

Submitted By: Tom Truscott
Cape Elizabeth High School

7 EDUCATIONAL TOY DESIGN

PROBLEM STATEMENT:

Your design team is assigned the task of developing an educational toy for the children of our high school's children center.

OBJECTIVES: The student will:

1. Develop leadership, cooperation, and responsibility skills working within the cooperative learning group.
2. Develop and/or apply their knowledge and skills in the areas of graphic communication, manufacturing, and public speaking.
3. Investigate marketing techniques to be applied toward promotion of their product.
4. Apply brainstorming and research skills for the solution to the design problem.
5. Investigate the needs, interests and abilities of 3-5 year old children.

MATERIALS & RESOURCES: There are no restrictions on the types of materials that can be used, providing they are readily available.

LIMITATIONS:

1. The group will have ten days to complete the design problem and have it prepared for presentation to the class.
2. The maximum cost for the prototype must not exceed $15.00.
3. The age range of the children is from three to five.
4. Items to be included as minimum requirements for the completion of the design problem are listed below:
   - Develop a design team logo.
   - Keep a design notebook including ideas, notes, sketches, research documentation, etc.
   - Complete the necessary working drawings.
   - Develop a promotional advertisement for the design.
   - Manufacture a working prototype.
   - Prepare a minimum five minute design presentation to be given in front of the class.
   - The design report must be prepared on a word processor.

EDUCATIONAL TOY DESIGN - 2

PROCEDURES:

1. Select a chairman for the group.
2. Brainstorm to generate potential design solutions.
3. Designate responsibilities for each team member.

- Chairman _____
- Logo design _____
- Advertisement _____
- Word processing _____
- Notebook _____
- Working drawings _____
- Presentation _____
- Prototype _____

EVALUATION: Group grade:

* Creativity	100 points
* Appeal to children	100 points
* Presentation	100 points
* Promotional material	100 points
* Notebook	100 points
* Prototype	100 points

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

This TLA is adapted from one presented by Kjell-Jon Rye of Bellevue, WA.

Submitted By: James Ray
Cape Elizabeth High School

8 SPACE STRUCTURES

PROBLEM STATEMENT: Using plastic drinking straws and common pins, construct a freestanding tower that can support a tennis ball at its pinnacle.

OBJECTIVES:

The student will be able to:

1. Discuss advantages and disadvantages of working in teams as compared with working as individuals to solve a problem.
2. Design a structure that will support a weight placed on top. Teachers may discuss the various forces and methods of calculating those that pull down on the tower when the weight is placed.
3. Construct the tower by developing efficient work techniques, and to discuss why certain techniques are more efficient that others.
4. Prepare for and work within a deadline when given a time constraint.

MATERIALS & RESOURCES:

For each team of three students:

- 200 Plastic Drinking Straws
- 100 Common Pins
- 1 Tennis Ball
- 1 Pair of scissors

For each class:

- 1 Tape measure (10 Foot Minimum)

LIMITATIONS:

- Construct a tower of plastic drinking straws and common pins.
- Scissors are the only tools permitted.
- Tower must be able to support a tennis ball at its pinnacle for a minimum of 60 seconds.
- Tennis ball may not be altered.
- Tower must be free standing.
- Time limit is 30 minutes.

SPACE STRUCTURES - 2

PROCEDURES: The activity works best with groups of three students. A short discussion of structures may precede the activity but is not essential as this is a discovery activity. Students should be cautioned about handling pins safely. Students should be instructed that to get credit, a working tower must be submitted, so height should not be the only goal. Straws and pins may be reused many times.

EVALUATION:

Tallest Tower	A
75% of tallest tower	B
50% of tallest tower	C
Tower holding ball for 60 seconds	D
No tower or non-conforming	No Credit

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

Submitted By: Richard P. Bray
Oak Hill High School

WASTE MANAGEMENT MEDIA SEARCH

PROBLEM STATEMENT: Investigate the issue of waste management and obtain a feel for the magnitude of the problem we face in this generation and in the future.

OBJECTIVES: The student will be able to:

1. Use the library to research topics in technology.
2. Write a position statement based on research of a technological issue.
3. Document sources of information used for research papers.
4. Make recommendations for dealing with waste and the environment, based on their research and attitudes.

MATERIALS & RESOURCES:

Library / Media Center
Computer / Word Processor

LIMITATIONS:

1. Using available resources, research the Waste Management issue and write a short paper (500 words) that will address two points:
   (A) A description of the overall waste management problem facing us and the urgency of our society to develop solutions.
   (B) Your personal views on this issue and what you sense as possible solutions for us and future generations.
2. Your comments on both A & B above should be supported, at least in part, by your research.
3. This is a position statement, and should reflect your attitudes about this issue and not list facts you may find in the research process.
4. Include a list of all references used in the paper.
5. Due Date: _____

WASTE MANAGEMENT MEDIA SEARCH - 2

PROCEDURES: Students are given one class period to visit the library/media center to research the topic. It should be stressed that this is a position paper and not the standard research paper that reports facts and descriptions of waste management systems. Possible subjects under which students might find information include:

Waste Management

Alternative Materials

Incineration

Re-cycling

Land Fill

Toxic Waste

Returnables

Trash to Energy

Hazardous Waste

EVALUATION: The papers should be evaluated based on completion of the limitations/task outlined above. Correct writing process, spelling and presentation should be considered. This activity is intended to allow students to express opinions on this issue as well as state the problems facing the world on this issue.

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

SUBMITTED BY: Richard P. Bray
Oak Hill High School

10 LONG DISTANCE VEHICLE - LDV

PROBLEM STATEMENT: Design, construct, and field test a vehicle powered by a CO_2 fire extinguisher to travel the greatest distance. (Speed is not essential - Distance is)

OBJECTIVES:

The student will:

1. Work cooperatively in a design team situation.
2. Generate ideas through brainstorming activities.
3. Develop positive attitudes while working in a competitive atmosphere.
4. Develop creative and critical thinking skills while working in a problem solving situation.

MATERIALS & RESOURCES: Materials for this problem should not be limited to what is available within the lab - they should be unlimited. Students should be encouraged to scrounge for parts, materials, or supplies and secure some form of financial backing.

LIMITATIONS:

- Time limit of 6 to 8 weeks (establish test date)
- Material cost not to exceed $ 20.00 not including the CO_2 Cylinder.
- Design Criteria (to be judged by instructor
  - A. Braking
  - B. Exhaust
  - C. Driver Escape
  - D. Safety
    - Minimum of two axles.
    - Senior driver only.

PROCEDURES:

- Form a design/construction team of 3-5 people.
- Research & test aerodynamic shape.
- Research ergonomic design engineering.
- Solicit financial aid/promoters, etc.
- Design & construct a working vehicle.
- Design a "Technology Education" logo to be placed on the vehicle.
- Develop/create a "Promo" video for your vehicle.

LONG DISTANCE VEHICLE - 2

EVALUATION:

Plans & Sketches 15%
- Brainstorming ideas/notes
- Development notes, daily log, accountability

Construction Details 15%
- Materials/Parts (Bill of Materials)
- Cost analysis including labor

Technology Education Logo 10%
- Logo printed on vehicle
- Wind tunnel models (2-3)

Acceleration Test of 300 feet w/calculations 10%
- Distance run with results.

Vehicle - Degree of Finish 10%
Vehicle - Aerodynamic Shape 10%
Vehicle - Styling 10%
Vehicle - Weight 10%
Vehicle - Quality of Work 10%

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

SUBMITTED BY: Rob Cronk
Wiscasset High School

THE "AMERICA'S CUP" CHALLENGE

PROBLEM STATEMENT: Design a wind-powered monohull vessel to travel a predetermined distance (by race officials) in the least amount of time.

OBJECTIVES: The Student will:

1. Work cooperatively in a design team situation.
2. Generate ideas through brainstorming activities.
3. Develop positive attitudes while working in a competitive atmosphere.
4. Work in a creative and critical thinking situation.

MATERIALS & RESOURCES: Materials for this problem should not be limited to what is available within the lab - they should be unlimited. Students should be encouraged to scrounge for parts, materials, or supplies and be resourceful in their use.

LIMITATIONS:

- Cost of materials not to exceed $ 5.00.
- Length of vessel is not to exceed nine inches (including bow sprit).
- The beam may not exceed one-half of the length of the vessel.
- Maximum sail area = 80 square inches.
- Test area of water will be at least 12 inches wide and 6 inches deep.
- Must have asthetic appeal.
- Time limit for completion: 6 days with testing on the 6th day.
- Crew size: three people.
- Vessel must be wind powered only.
- Include a spec sheet with the following data: LWL, LOA, Displacement, Sail Area, Mast Height & Draft.
- Group must choose a country capable of challenging the America's Cup.

PROCEDURES:

- Form a racing team to consist of a "Captain" and two "Crew" members.
- The vessel will represent a financially capable country other than the United States.
- The vessel must be named in the language of the country represented.
- The vessel must fly the flag of the country represented.
- Prepare two types of reports (one oral and one written) which include the following information:
    A. Country Information in folder form
        1. Location of capital by latitude & longitude coordinates - pointed out on a globe or chart.
        2. Flag colors & design on the boat and folder.
        3. Population
        4. Imports/Exports

5. Capital
6. Language
7. Climate
8. Type of government

B. Drawing and explanation of the type of hull design you chose.
   - Reason you chose that particular design
C. Drawing and explanation of the rigging
   - Why did you chose the rigging
D. List of materials used and why you chose those materials.
E. Completed specification sheet
F. Completed terminology sheet

EVALUATION:

Vessel which travels from point A to B in shortest time	50 Points
Vessels with 75% of fastest time	25 "
Vessels with 25% of fastest time	10 "
Vessels with most asthetic appeal(By vote of class)	25 "
Vessels with best hull design(By analysis & vote of class)	25 "
Vessels with best deployment of sail area	25 "
Attention to detail	10 "
Spec Sheet	24 "

(To qualify for an extra 50 points your group must do an oral class report on the country that you represent)

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

Teacher may develop a test tank suitable for testing the vessels. This tank should be a minimum of 6" deep, 12" wide, and 8 feet long.

NAUTICAL TERMINOLOGY:

LOA	= Length over all
LWL	= Length at the water line
Displacement	= The weight of the vessel
Beam	= Distance across the width of the vessel at widest point
Draft	= Amount of water vessel draws from water line to bottom of keel
Rudder	= Steering mechanism

SUBMITTED BY :

Rob Cronk - Wiscasset High School
Fred Lewis - Boothbay Region High School
Clive Farrin - Boothbay Region High School
Bill Carney - Poland Community School
Paul Johnston - Elm Street School - Mechanic Falls
Phil Merrill - Rumford JR/SR High School

TECHNOLOGY EDUCATION

IN MAINE

SECTION V
APPENDIX

ADDITIONAL RESOURCES

International Technology Education Association (ITEA)
1914 Association Drive
Reston, Virginia 22091-1502

Maine State Library
Station #64
Augusta, Maine 04333
(207) 289-5600

Technology Education Electronic Bulletin Board
Part of ..... ME-LINK (Electronic Information Service for Maine Educators)
Maine Computer Consortium
Division of the Maine Center for Educational Services
P.O. Box 620
Auburn, Maine 04210
Phone..... 207-783-0833 (Voice) 207-783-9776 (ME-Link)

Technology Education Association of Maine (TEAM)
c/o State Technology Education Consultant
(address below)

The Information Exchange
1-800-322-8899

University of Southern Maine
School of Applied Science
Department of Technology
Gorham, Maine 04038

Vocational Curriculum Resource Center of Maine
KVVTI
P.O. Box 29
Fairfield, Maine 04937
(207) 453-9762 ext. 170

A list of additional resource people and organizations can be obtained by contacting:
Dr. Ed W. Taylor
Technology Education Consultant
Maine Department of Education and Cultural Services
State House Station #23
Augusta, Maine 04333
(207) 289-5854

GENERAL RESOURCES IN TECHNOLOGY

A suggested list of available resources, by no means all inclusive.

DeVore, P. W. (1980). TECHNOLOGY an introduction. Worcester, MA: Davis Publications, Inc.

Fales, J. F. and Kuetemeyer, V. F. (1988). Technology today and tomorrow. Mission Hills, CA: Glencoe Publishing Co.

Fuller, B. R. (1983). Inventions. New York, NY: St. Martin Press

Goetsch, D. L. & Nelson, J. A. (1987). Technology and you. Albany, NY: Delmar Publishers, Inc.

Hacker, M. and Barden, R. A. (1988). Living with technology. Albany, NY: Delmar Publishers, Inc.

Hacker, M. and Barden, R. A. (1988). Technology in your world. Albany, NY: Delmar Publishers, Inc.

Heiner, C. W. and Hendrex, W. R. (1980). People create technology. Worchester, MA: Davis Publications, Inc.

Listar, G. (1987). Technology activity guide - 1. Albany, NY: Delmar Publishers, Inc.

Listar, G. (1988). Technology activity guide - 2. Albany, NY: Delmar Publishers, Inc.

MacAulay, D. (1988). The way things work. Boston, MA: Houghton Mifflin Co.

McCory, D. L. and Maughn, G. R. Resources in technology. Worcester, MA: Davis Publications ,Inc.

Micklus, S. C. (1988). Making learning activities fun, activities to develop creativity. Glassboro, NJ: Creative Competition, Inc.

The Commission on Technology Education for the State of New Jersey. (1987). Technology education: learning how to learn in a technological world. Aberdeen, NJ: Vocational Education Resource Center.

New York State Depaertment of Education. (1986). Technology education introduction to technology - grade seven . Albany, NY: New York State Education Department.

New York State Depaertment of Education. (1986). Technology education introduction to technology - grade eight . Albany, NY: New York State Education Department.

GENERAL RESOURCES IN TECHNOLOGY (Cont.)

Rutherford, M. A. and Rye K. J. (1989). Living with technology - teacher's resource book. Albany, NY: Delmar Publishers, Inc.

Standards for Technology Education Project. (1985). Standards for technology education programs. South Holland, IL:The Goodheart-Wilcox Co., Inc.

Todd, R., McCrory, D. & Todd, K. (1985). Understanding and using technololgy. Worcester, MA: Davis Publications, Inc.

Virginia Department of Education. (1988). The technology education curriculum K-12. Glen Allen, VA: The Virginia Vocational Resource Center.

Waetjen, W. B. (1989). Technological problem solving. Reston, VA: ITEA.

Wright, T. and Sterry, L. Industry and technology education - a guide for curriculum designers, implementors, and teachers. Lansing, Ill: Technical Foundation of America

COOPERATIVE LEARNING

As teachers become involved with Technology Learning Activities (TLA's) they will find themselves in more and more situations that require students to work in groups. These groups may be student formed companies or a groups chosen to perform some activity. The groups may vary in size from as few as two members up to an entire class. The ability to function as a member of a group is not an innate ability; it is a learned one. The students ability to cooperate with the teacher and team members is essential to a successful TLA.

Most TLA's consist of several sections: design, construction, testing and evaluation. For example, you may find yourself with ten students in a group; nine want to pound nails and one would help with the design if needed. You can threaten failure, upset students, upset yourself, etc., but there are other and much nicer ways which tend to keep (most) students and instructors smiling. A little time spent studying cooperative learning and then a little time spent working with students on cooperative learning, will (may) solve the problem, or better yet, prevent the problem from ever occurring.

This curriculum guide was not intended as a Cooperative Learning Guide, and therefore the most it can do is:

1. Make you aware that the lack of cooperative learning skills may be the cause of TLA failure, rather than the TLA itself.

2. Direct you to some sources of Cooperative Learning Materials:

SELECTED MATERIALS ON COOPERATIVE LEARNING

Books

Aronson, E., et al. (1978). The jigsaw classroom. Beverly Hills, CA: Sage Publications. 197 pp.

Johnson, D.W. (1986). Reaching out: interpersonal effectiveness and self-actualization (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Johnson, D.W., Johnson, R. (1987). Joining together: group theory and group skills (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Johnson, D.W., Johnson, R. (1987). Learning together and alone: cooperative, competitive, and individualistic learning (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Johnson, D.W., Johnson, R., and Holubec, E. (1986). Circles of learning: cooperation in the classroom (Revised Edition). Edina, MN: Interaction Book Company.

Johnson, D.W., Johnson, R. (1987). A meta-analysis of cooperative, and individualistic goal structures. Hiddsdale, NJ: Lawrence Erlbaum.

Kagan, S. (1985). Cooperative learning: resources for teachers. Riverside, CA: University of California. 300 pp.

Okebukola, P. A. (1986). "Cooperative learning and students attitudes toward laboratory work." School Science and Mathematics, 86, 582-590.

Slavin, R. E. (1983). Cooperative learning. New York: Longman.

Slavin, R. E. (1986). Student team learning: an overview and practical guide. Washington, D. C.: National Education Association. 79 pp.

Slavin, R. E. (1986). Using student team learning (3rd ed.). Baltimore, MD: Center for Research on Elementary and Middle Schools, The Johns Hopkins University.

Slavin, R. E., et al., (Eds.). (1985). Learning to cooperate, cooperating to learn. New York: Plenum Press. 472 pp.

Wood, K. D. "Effective content area instructional practices". In Dishner, E.K., Bean, T. W., Readence, J. E. & Moore, D. W. (Eds.). (1988). Reading in the Content Areas: Improving Classroom Instruction. Dubuque, IA: Kendall/Hunt.

Wood, K. D. (1985). "Free associational assessment: an alternative to traditional testing." Journal of Reading, 29, 106-111.

Teacher Materials

Johnson, D.W. , Johnson, R. T. (1985). Cooperation in the classroom . Edina, MN: Interaction Book Company.

Johnson, D.W. , Johnson, R. T. (1985). Cooperative learning: warm-ups, grouping strategies and group activities. Edina, MN: Interaction Book Company.

Johnson, R.T., Johnson, D.W. & Holubec, E.J. (1987). Structuring cooperative learning: lesson plans for teacher. Interaction Book Company, 7208 Cornelia Drive, Edina, MN 55435

Movies

Johnson, D.W. and Johnson, R.T. (Producers), 1980. Belonging. 16 mm film or VHS videotape, 27 minutes. Edina, MN; Interaction Book Company.

Johnson, D.W. and Johnson, R.T. (Producers), 1983. Circles of Learning. 16 mm film or VHS videotape, 32 minutes. Edina, MN; Interaction Book Company.

PROBLEM SOLVING IN TECHNOLOGY EDUCATION

One of the distinguishing characteristics of technology education is an increased and somewhat different focus on problem solving. Problem solving activities can contribute to the achievement of all the objectives of technology education (see page 1-6), but focus specifically on the development of critical thinking skills necessary to evaluate technology and its products in their environmental, cultural, and personal contexts; and on the development of creative problem solving skills necessary to identify, develop, implement, and evaluate solutions to technical problems (objectives # 1 & 5, page 1-6).

The programs that have preceded technology education have always required problem solving, so, an examination of how it differs in technology education is important. It differs in that increased importance is given to problem solving, the nature of the problems situations presented to the students, the method the students are expected to use to solve the problems, and the way in which their efforts are evaluated.

In technology education, the development of problem solving skills is considered to be more important than the development of tool using skills or the understanding of specific technical knowledge. Tool skills and knowledge are important, but are viewed more as means to develop problem solving skills rather than ends in themselves.

The nature of the problems differ in that they are broader in scope, less well defined, and require higher levels of cognitive activity such as analysis, synthesis, and evaluation. They are broader in scope in that they go beyond the making of products and include basic design and investigative studies relating to environmental, cultural, and historical relationships.

They differ in the way they are presented to students by being presented as real problems to be solved through investigation and design rather than just objects to be built. For example, when a student is assigned or selects to build a shelf, the solution is known - a shelf - and requires little analysis, synthesis, or evaluation of alternatives. If ask to solve a storage problem, however, the student is required to analyze the situation, identify possible solutions, select between alternatives, develop details, and evaluate the results relative to the problem, as well as construct an object. As the students progress, the problems become less well defined and more complex to require even higher levels of thinking.

The problems are approached in systematic ways that represent the techniques used by designers, engineers, and scientists. The methods used include various forms of problem analysis through research, creative idea generation, evaluation of alternatives, detail development, construction of prototypes or plans of action, and critical evaluation of the results.

Finally, the students efforts are evaluated through an examination of their use of the problem solving methods and not by grading only the object. In such evaluations, evidence of the developmental stages of the students work is many times presented in portfolios which are used to provide the basis for grades.

Problem solving in technology education differs significantly from much of that found in previous programs, and requires that many technology educators develop their own understanding of it characteristics and methods. The following list is a brief sample of the growing body of literature available to assist in that development.

Anderson, Lowell D. (1989, September / October) "Problem solving in technology education", The Technology Teacher., 49; pp. 3-7.

Barnes, Wiatt, & Bowen. (1990, January) "The NASA / elementary technology education project", The Technology Teacher., 49; pp. 13-17.

Cross, Nigel. (1989) Engineering design methods, John Wiley & Sons.

Hanks, K., Belliston, L. & Edwards, D. (1978) Design yourself, Los Altos, California: William Kaufmann, Inc.

Hatch, Larry. (1988) " Problem Solving Approach ", in The 37th. Yearbook of the Council on Technology Teacher Education: Instructional strategies for technology education, pp. 87-98.

Hutchinson, P., Davis, D., Clark, P. & Jewett, P. (1989, November / December) " The Design Portfolio: Problem -Solving Illustrated", TIES., pp. 17-27.

Hutchinson, Patricia. (1989, March / April) " Ideas Take Shape: Models To Fool The Eye", TIES., pp. 23-30.

Koberg, D. & Bagnall, J. (1981) The all new universal traveler, Los Altos, California: William Kaufmann, Inc.

Sellwood, Peter. (1989, December) "The Roll of Problem Solving in Developing Thinking Skills", The Technology Teacher. 49; pp. 3-10.

Yarwood, A. & Orme, A. H. (1983) Design and technology, Sevenoaks, Kent, England: Hodder and Stoughton.

Zaner, John A. (1987, April) " Problem Solving in Technology Education", Industrial Education ., p. 35.

TLA OUTLINE

TITLE:

PROBLEM STATEMENT:

OBJECTIVES:

MATERIALS & RESOURCES:

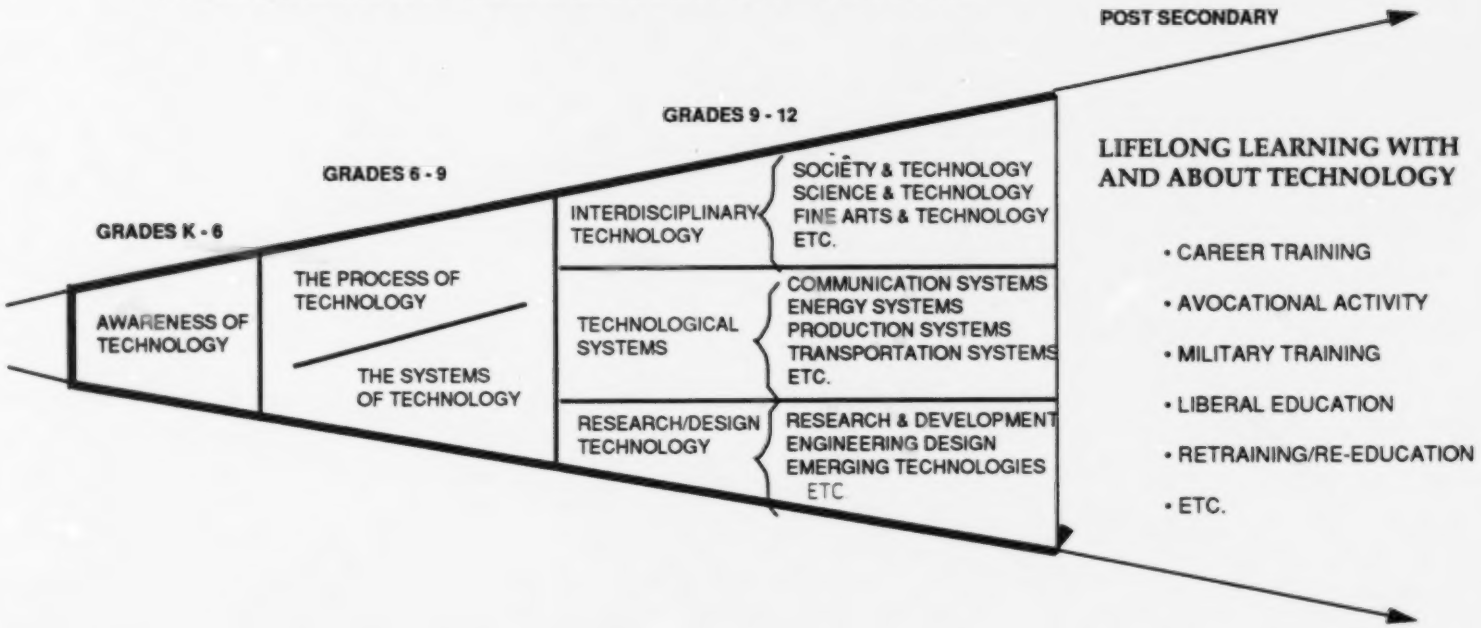
LIMITATIONS:

PROCEDURES:

EVALUATION:

FEEDBACK FROM STUDENTS & SUGGESTED CHANGES FOR IMPROVEMENT:

CURRICULUM MODEL FOR TECHNOLOGY EDUCATION IN MAINE

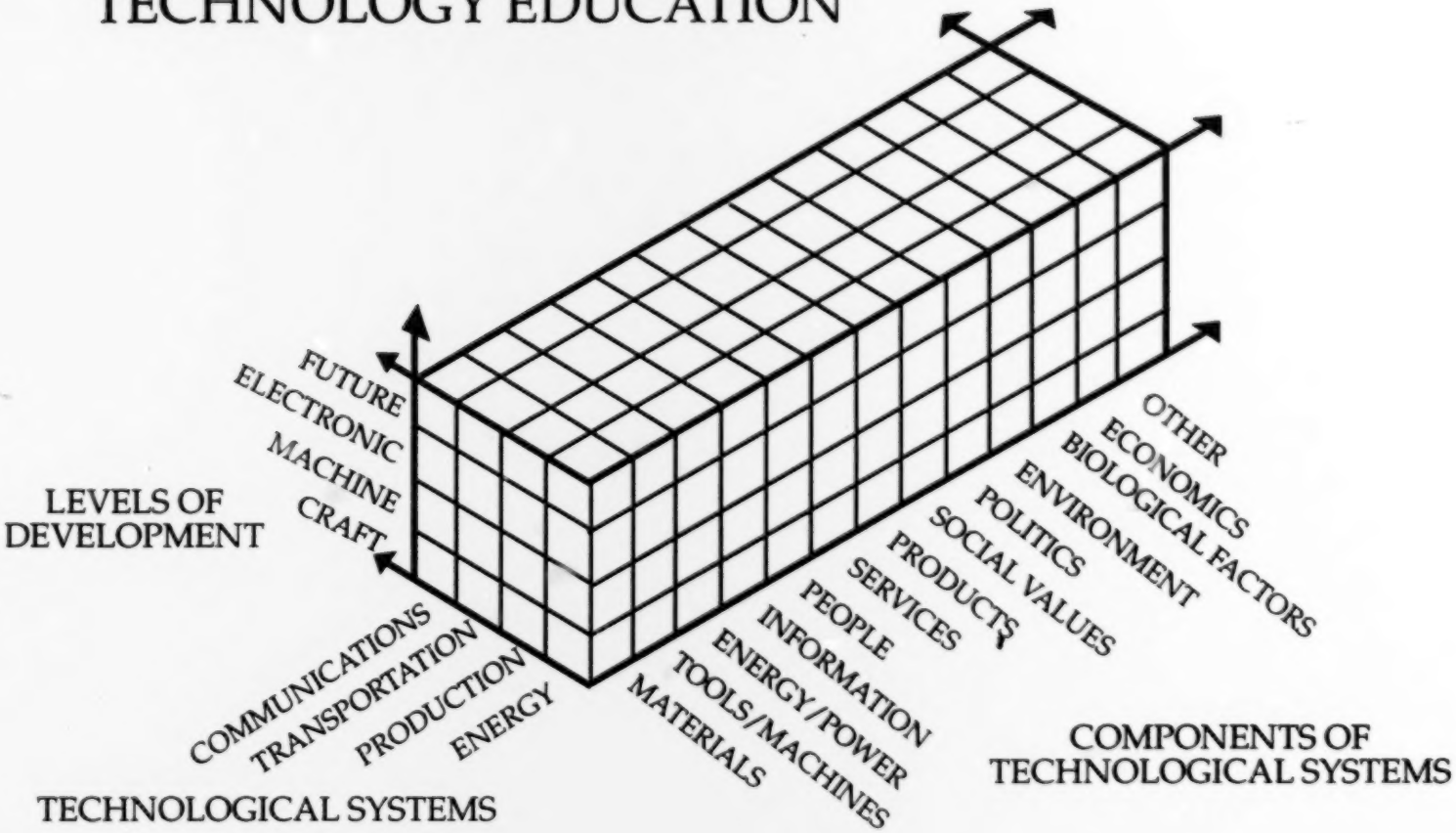


THE FOLLOWING THEMES/CONCEPTS ARE COMMON TO ALL OF TECHNOLOGY EDUCATION:

Historical Context ——————————→
Problem Solving ——————————→
Cultural/Societal Impacts ——————————→
Career Literacy ——————————→

A-9

CONTENT MODEL FOR TECHNOLOGY EDUCATION



TECHNOLOGICAL PROBLEM SOLVING
A PROCESS MODEL FOR TEACHERS AND STUDENTS